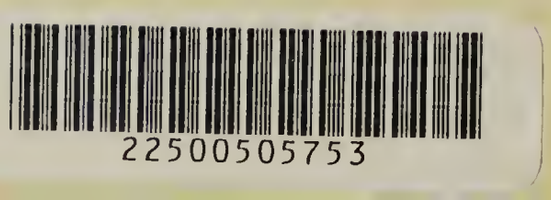
SCIENCE SIFTINGS


22500505753

WELLCOME INSTITUTE
LIBRARY
Coll. WelMOmec
Coll.
No.

"KNOWLEDGE IS POWER."

INDEX TO VOLUME II.

A.

Africa's Pigmies, 361
Ancient Builders Built, How, 204
Ancient Remains, 10
Animals, Time Sense in, 82
Ant, A Brainy, 181
Ants, More Brainy, 286
Ants, 67
Astronomy Graphically Portrayed, 37
Astronomy and Photography, 110
Auk's Egg, The Great, 220
Avernus, A Real or Imaginary Lake, Was? 165

B.

Baby's Footprint, A, 134
Baby's Burden, 151
Bacillus, The History of a, 189
Bears Like Honey, 343
Bee's Eyes, A, 206
Blind Man's Perception, A, 360
Boy's Invention, A, 179
Boomerangs and Flying Machines, 20
Brains, Interesting Facts About, 137
Brown Bread is Bad, Why, 146
Brown Bread is Good, Why, 193
Brute to Man, Rise From, 287, 305

C.

Cat, An Eccentric, 300
Cats and Dogs, Prehistoric Monster, 92
Celestial Wanderers, 277
Chance, No Such Thing as, 176
Charge Refuted, A, 272
Cheese, Danger of, 320
Chemical Experiment, A, 207
Chrysanthemums, About, 345
Coal, The Origin of, 230
Complexion, Science of the, 77
Constitutions, Constructing, 359
Cosmetics, 204
Cremation, The Cost of, 334
Criminology, Recent Researches in, 259, 275

D.

Damp Extractor, A, 334
Death Begin? When Does, 151
Death, Shamming, 320
Decayed Matter gives Life, How, 347
Diamonds in Meteorites, 13
Diatoms? What are, 122
Doctors' Blunders, 360

E.

Ear, The Human, 358
Earth a Shell with Fluid Filling, The, 62
,, The Past of the, 93
,, How Old is the, 249
Earthquakes, The Cause of, 90
Eccentric Inventions, 8
Electricity Analysed, 22
,, will Kill, How Much, 160
Electric Belt Quacks Exposed, 216
Electropathic Frauds Exposed, 231, 258, 301, 314
Electric Light in Medicine, 220
"Electrical Review" Paragraph, 330
Electricity, Human, 358
Elephant's Palate, An, 11
Energy and Ether, 94, 107
Etna's Eruptions, 244
Evolution and Physical Development, 7
,, of Infinite Involution, The, 76
Experiment in Analysis, A Simple, 330
,, A Strange, 350
Eyes, How to Test the, 249

F.

False Gems, Testing for, 140
Family Traits, The Persistency of, 119
Figures, A Wonder in, 248
Fire, The Philosophy of, 90
,, Prevention, 118
,, How to Eat, 202
Flies, The Fecundity of, 50
Flying Ships, More About, 51
Flower, Evolution in the, 104
Flowers, Preservation of, in Their Natural Form and Colour, 221
Fossils, 218
Food Fallacy Exploded, A, 219
Fruits, Utility of, 333

G.

Garner, Professor, and the Gorillas, 48
Ghosts? What are, 35
Glacial Period, A Coming, 206
GLEANINGS OF THE GLOBE, 4, 18, 32, 46, 60, 74, 88, 102, 116, 130, 144, 158, 172, 186, 200, 214, 228, 242, 256, 270, 284, 298, 312, 326, 340, 354
Glass Eye, The, 140
Goodwin Sands, The, 66
Government, The Science and Art of, 209
Gun-Armed Antediluvians, 25

H.

Harness's, Mr., Invitation to "Science Siftings," 315
Health, How to Preserve, 235
HELPFUL HINTS, 13, 27, 42, 56, 69, 83, 97, 111, 125, 153, 168, 182, 196, 210, 238, 252, 266, 280, 294, 308, 322, 336, 350, 364
Holmes, Dr., On Trees, 135

LONDON: 78, FLEET STREET, E.C. 1892.

Homœopathy, 81
Homœopathy, Another Opinion on, 192
Honey, What it Takes to Make, 250
Horses, How to Keep, 258
Hot Weather, What to Eat in, 175
How Steam Engines are Made, 8
Human Body, The Garrison of the, 356
Human Flight Ridiculed, 174
Hygienic Appliance, A, 308

I.

Ice Machine, The First, 315
Ices, Mechanical, 65
Infection, Clouds of, 318
Inoculating Plants, 81
Insects, Useful, 278
Interior of the Earth Solid ? Is the, 108

J.

Japanese Burial Costume, An Ancient, 304

K.

Keely Motor, The, 91
Kite Electricity, 138
Knowledge of Nature, 174

L.

Lady Birds, 153
Land was Separated, How the Dry, 343, 357
Latitude, Variable, 95
Leading Opinions on Space, 138
Life in Other Worlds, 149
Light, A Theory of, 346
,, Go, Where Does ? 24
Lightning, The Power of, 289
Long Ago, Science of, 233

M.

Man ? How Old is, 55
,, in the Ice Age, 125
Maori Version of the Deluge, 66
Mars, Communication with, 179
,, Moons, 205
,, is Upon us, 263
,, What we have Learned about, 289
,, Satellites, More about, 302
Match, The First, 304
Mattei's Remedies, Count, 194
Mercury, Marvellous, 221
Microbes are Killed, How, 328
Microscope, Marvels of the, 52
,, Caring for the, 288
Milk, Sterilising, 341
Mind Man's Property ? Is, 133
Modification of Our Climate, 37
Monkeys, Wild, in Europe, 196
Morley Memorial College, 344
Motion, Perpetual, 50
Motions of the Heavenly Bodies, 34
Murder and the Microscope, 118
Music Among Animals, 319
Mystery of Nature, A, 27

N.

Nature, The Forces of, 177, 191
Nervous System, An Overdraught on the, 342
Noah's Ark Just Found, 272

O.

Oxygen or Ozone, 9
Ocean, Mysteries of the, 48
,, Terrors of the, 273

P.

Paper is Made from Wood, How, 329
Perpetual Motion Controversy, The, 178
,, ,, Possible ? Is, 260
Photographic Competition, Our, 166
,, Appliances, Improvements in, 332
Poison ? What is, 21
roblem of Trans-Atlantic Telephony Solved, The, 10
Projectile, A Terrible, 163
Protoplasm and the Potato, 250
Population of the Earth, 23
Psychological Training, 245

Q.

Quacks Prosper, How and Why, 286

R.

Reasons for Baldness, 34
Restoration of Rameses, The, 39
Railway, The Evolution of the, 78
Rain To-Day ? Shall we have, 109
Rhythm in Plants, 348

S.

Salt and a Glass of Water, A Lump of, 135
,, The Use of, 151
,, of the Sea, The, 266
Science is Backward, Why, 120
"Science Siftings" Puzzle, 126
Science and Art, 300
Scientists, Strange, in Paris, 292
Sex in Education, 106
Second of Time, A, 306
Sense of Direction ? Is there a, 317
Shepherd's Star, The, 233, 247
Shooting into Infinite Space, 332
Simple Process for Coloring Photographs, 24
Sun Hypothesis, A, 25
Singularities of Suicide, 188
Sit, The Proper Way to, 106
Smell, The Sense of, 105
Simple Causes Effect Big Results, 244
Social Science on the Stage, 50
Songsters, Remarkable, 264
Spiders, 193
,, Singularity of, 261
Speaking Along a Ray of Light, 329
Storms, Siftings About, 303
Star that no Man has Seen, 6
Stone Age in Iceland, The New, 363
Suez Canal, 302
Sun Must Die, When the, 121, 132
Syphon Clock, The, 290

SCIENCE NEWS AND NOTES, 1, 15, 29, 43, 57, 71, 85, 99, 113, 127, 141, 155, 169, 183, 197, 211, 225, 239, 253, 267, 281, 295, 309, 323, 337, 351
A New Use for Oil at Sea, 16
Aerolite, An Enormous, 157
Aerial Navigation, 297
Africa, In South Western, 199
Agriculturalists, An Interesting Note for, 227
Alphabet, The, 86
Alcoholism, Vexed Question of, 99
Animals and Machinery, 44
,, The Intellect of, 86
Ants, Our Article on, 59
Ancestral Traits, The Survival of, 100
Anthropology, The Fundamental Question in, 114,
Anti-Cremation Argument, The Strongest, 85
Anthropology, The Fundamental Question in, 171
Anthropology, 295
Ammonia for Electric Shock, 115
April has Gone, 29
Armour, Remarkable Invention in, 297
Archœological Research, 199
Artificial Aurora, An, 3
Artificial Diamonds, 3
Atlantic, The Bed of the, 3
Athletics, The Reform of, 16
Atmospheric Circulation, 297
Auroras, Tidings of, 59
Aurora Borealis, The, 185
Australia and Africa, 213
,, Exploring the Interior of, 213
Baking Powders, 310
Bacillus, Farmer Claims the, 213
Bacteria are not Wholly Bad, 156
Balloon Voyage, A, 73
Ballooning, 269
Bee, The Bumble, 44
Birds, Longevity of, 297
Blood, Infusion of, 324
,, Poverty of, 337
Blushing, The Cure for, 113
,, Physiology of, 338
Boiled Water, The Virtue of, 31
Brain Workers, 30
,, Work, The Best Way to Do, 72
Bread, The Dietetic Value of, 57
Breathing, The Act of, 183
Buried Alive, 254
Camera—Weapon of Warfare, 241
Can the Telephone Communicate Disease ? 30
Cardinal Points Without a Compass, 2
Catarrh, Chronic, 169
Cat, Left-Handed, 310
Cave Dwellers of Central Asia, 295
Character Telling by the Teeth, 171
Charge of Impeding Scientific Progress, 115
Chastisement, The Ethics of, 2
Cholera, Spread of, 269
,, The Way to Stamp Out, 310
,, We are Face to Face with the, 197
Cinnamon is Another Disinfectant, 211
Cities, The Overcrowding of, 71
Cleopatra and the Pearls, In Speaking of, 157
Climate, Change of, 255
Clouds, The Investigation of, 2
Coal, The Carriage of, 73
Cobwebs, 30
Cold, A Common, 141
,, Bathing, 225
,, Weather, A Possible Cause of the Late, 143
Constellation, A New Heavenly, 101
Contagious or Infectious Disease, In the Presence of, 141
Cookery Civilises, How, 227
Courage, Physical, 85
Cremation, Compulsory, 309
Cycling, Evils of, 338
Dead Sea, The Waters of the, 184
Death Watches, 226
,, How to Tell, 86
,, in the Teapot, 16
Dependence of the Brain Upon the Blood, The, 169
Depopulation of France, 269
Detective Microphones, 156
Disease, 15
,, A New, 113
,, The Relation of Physical and Mental, 43
Discovery, The Russians have Made a Singular, 45
Dreams, The Physiology of, 58
Drink ? What Shall We, 296
Dynamo, The, 114
Earth, The Curvature of the, 87
Earwig in the Ear, An, 113
Eating, Excessive, 240
Education and Thoughtfulness, 86

337145

Edison's Rinetograph, 353
,, Mr., Communications, 31
Electricity, The Importance of, 1
,, a Myth? Is, 45
,, Stealing, 73
Electrical Device, A Simple, 142
Electric Light Bath, An, 155
Electricity will Do Much for Sanitation, 198
,, Truant, 212
Edison Originated Electrocution, 115
,, as a Man, 129
Elastic Vegetable Material, An, 170
Electric Belt Quacks, Our Article On, &c., 225, 239, 267, 281, 309
Elephant, The Language of the, 73
Electrocution, 58
Emotions, Concerning the, 211
Emu Hunting, 101
Ether, The Hypothetical, 352
Evolution, A Believer in, 2
Exercise, An Inordinate Amount of, 240
Female Education, The Question of, 72
Fishes, A Collection of the Oldest, 72
Flats, The Fatality of, 85
Flint and Steel Theory, The, 17
Flying Machine, The New, 100
Flying Machine, 241
Fly Trap, An Electric. 325
Fog Annihilator, An Electrical, 184
Fogs, The Advantages of, 155
Food, Organic, 57
,, Supply, Scarcity of, 310
Four Thousand Pounds Prize, The, 101
Good Health, To Insure, 211
Growth of Plants at Night, The, 30
Gun, A Silent,
Habit is Second Nature, 15
Hanging, The Cause of Death by, 59
Hat, Why Wear a, 351
Head Masters, Our Invitation to, 155
Head, Poise of the, 296
Heat, Extraordinary, 225
Heat Wave, The Fearful, 281
Hedgehog, New Light on the History of, 353
Hereditary Transmission of Mutilations, The, 142
Hieroglyphic Writing, The Early Egyptian, 87
Horrors of the Highway, The, 142
House Flies are not usually Regarded as Dangerous, 211
Human Skull, The Evolution of the, 114
Human Skull, Evolution of the, 296
Hygrometer, A Useful, 115
Hypnotism by a Snake, 31
Ice, The Strength of, 185
Illumination, A Vast Improvement in Artificial, 101
Immunity from Second Attacks of Certain Diseases, 142
Inventions, Many, 3
Insanity may be brought about, 1
Is Life being Shortened? 29
Juvenile Smoking, 183
Kelvin, The, 114
Kepler's Great Discovery, 241
Labor, The Physiology of, 57
Land and Water of the Globe, The, 115
Lepers are Electricity-proof, 115
Lightning, Striking of Ships by, 129
Light is Essential to the Creation of Colour, 143
Live without Eating, To, 183
Mackerel Blind, Are? 142
Magnets, Influence of Steam upon, 339
Mal de Montague, 254
Mars, The Planet, 157
Mars is in Brilliant Form, 240
Massage, 43
Mathematics, The Science of, 17
Maxim has been Outdone, 16
Measuring Water, A Method of, 212
Medical Science, 44
Meteor said to be Half Gold, 325
Mercurial Pump, The Giessler, 45
Mirage, The Direction of a, 44
Microscope, The, 100
Milk, Man Still Uses, 156
,, Boiling of, Before Consumption, 268
Modern Science, One of the Mysteries of, 59
Mongoose, The, 128
Muscles, A Man who Spells with his, 128
Natural Phenomena, Some Magnificent, 227
Nervous Diseases, The Inheritance of, 43
Nervous System, 141
New Title, Eighty Suggestions for Our, 211
Niagara, The Power of, 45
Paper Money as a Medium of Infection, 225
Parasite, The Mode of Destruction of the, 100
Pasteur Treatment, The, 155
Patent Medicines, 185
Phenomenon, A Curious, 213
Physiognomy, 2
Physiological Effects of Electric Currents, 128
Physical and Mental Correlations, 171
Physical Insensibility of Women, The, 198
Photographic Camera, 254
Porcelain Portraits, Our, 113
Prehistoric Mound, A, 86
Prize We are Offering, The, 225
Prehistoric Drawings, Some Interesting, 227
Psychology, Experimental, 86
,, A Congress for Experimental, 226
,, The Study of, 226
Pulse, Beating of, 310
Railway Accidents, 128
Rain Making, 101
,, Artificial, 311
Reactions of Mind on Body, The Physical, 43
Recent Examination of the Spectrum of Mars, 17
Respiration, New Method of Producing Artificial, 269
Saddles, Scientific, 255
Salads, Physiology of, 296
Salt, The Utility of, 57
Sanitation of Houses, 268
Scientific Phenomenon, 16
Science Siftings, 183
Sea-Calming Invention, A Remarkable, 170
Sea Bathing, 184
Sea-Shore Sands, The, 212
Sea-Sickness, The Ethology of, 351
Sense of Direction, 352
Serpent, The Sea, 58
Sign Speaking, 185
Silent Language, The, 199
Shade Plants, 143
Shower of Mud, A Remarkable, 45
Sleeplessness, 127
Smoke Nuisance, The, 31
,, Question, The, 44
Smoke, The Utilisation of, 184
Snail, Article of Food, 310
Snakes, Tenacity of Life Possessed by, 297
Snoring, 183
Speed of the Pulse, 30
Spencer, Mr. Herbert, 226
Spiders, The Sociability of, 283
,, Intelligence of, 339
Spontaneous Combustion, 283
Strains on Bridges, 3
Sunlight, The Vitalising Energy of, 155
Sunniest Spots in the Kingdom, 212
Sun Spots, The Theory of Relation Between, 171
Sunstroke and Heat Apoplexy, 281
Supernatural, Things, 352
Tapping the Telegraph Wires, 87
Telegraph, A Magnetic, 114
Teeth, Hygiene of the, 253
Ten Species of Micro-Organisms, 16
Tesla, Mr., 58
Tides and the Weather, 255
Tile Fish, The History of the, 156
Tinned Foods, Curiosities of, 324
Title, Our, 197, 267
Thirst, The Phenomenon of, 282
Thirst-Quenching, 339
Thought Transference, Theory of, 283
Thiee Years Too Late, 31
Thunderstorms, A Theory of, 100
,, The Generation of, 255
Toothless Future, Civilised Man is Threatened with a, 97
Tobacco Habit, The, 211
Trackless Ocean, The, 3
Trees, Our Plea for, 85
Tricycles, Practical Water, 324
Vacuum, The Formation of a, 45
Value of a Pig's Hide, The, 17
Vegetarians and Animal Feeders, 15
Volume of "Science Siftings," A, 141
Warmth as a Factor of Health, 1
Wash all Food, 17
Water, Walking on, 227
Weight of a Person, The Proper, 324
Why are Pigs not Skinned, 17
Wine, Purity of, 269
Women, The Physical Education of, 99
SCIENCE QUERIES AND ANSWERS, 5, 19, 33, 47, 61, 75, 89, 103, 117, 131, 145, 159, 173, 187, 201, 215, 229, 243, 257, 271, 285, 299, 313, 327, 341, 355
Aerial Navigation, 327
Air, Dust-Free, 5
Altitude at which Man can Live, 75
Animals' Digestion Effected, 131
Animalculæ in Water, 313
Apple of Sodom, 257
Artists' Colors, 131
Arsenic in Wall Paper, 313
Atom and Molecule, Difference Between, 355
Aurora Borealis, 47
Bleaching, 285
Bones become Weaker with Age, 61
Botanical Specimens, Preserving, 61
Burning Glass, Power of, 89
Calorescence. 173
Cannon Balls, Collision of, 33
Candle, Where does Light go to when Blown Out, 299
Cheques Protected against Forgery, 285
Chemical Element, 145
Chronometers and Pendulum Timepieces, 160
Clouds, 47
,, How Large are Drops of Water in, 103
,, How Formed, 229
Clock Regulating, 89
Coal, Mechanical Effect Obtained from, 19
,, How Long will Supply Last, 33
Colloid Material? What is, 19
Cold Fluids in a Heated Condition, 355
Colors Fade when Exposed to Sunlight, 271
Copper Prepared from its Ores, 271

Color Photography, is it possible? 299
Color? What is, 341
Compass Used in High-Class Vessels, 187
Coins, Deciphering Inscriptions on Old, 201
Conjurers Produce Fiery Sparks from Mouth, 201
Cooking, 243
Daylight? What is, 327
Differential Calculus, 229
Diffraction Spectrum, 131
Digestion of Food, Influence Pulse, 19
Earth-Moon System, Ultimate Fate of, 103
Earth, Matter at the Centre of, 173
Earthquake, Cause of, 299
Earth's Rotation Decreasing, 75
,, Centrifugal Force, 103
Earth's Surface, Greatest Portion Seen at Once, 117
Earth's Atmosphere, 355
Egg, Distinguish Boiled from Unboiled, 61
Eggs, Way to Cook, 33
Electric Arc Light, 5
Electric Batteries, 47
Electrical Radiations, 173
Electricity Measured, 215
Electrical Radiation, 229
Electric Lamp, Filament of, 229
Elasticity, 201
Electro-Plating? What is, 145
Eye, "Blind-Spot" in, 201
Eyes in Painted Portraits, 201
Firedamp, 327
Fish, Salt Water and Fresh, 243
Flint and Steel, Sparks from, 229
Fruit More Wholesome in Morning, 271
Fuel, Value Determined, 159
Gas at Very High Pressure, 173
,, and Vapour, Distinction, 145
Glass, Unbreakable, 243
Gold, Metals More Costly Than, 187
Gravitation, Probable Cause of, 131
Gunpowder, Explosion of, 313
Hailstones, 257
Heart, Action of, 19
Heat Radiated by Sun, 61
Henbane, Madness Results from Eating, 201
Homœopathic Treatment, 47
Horse Power, Senses of Word, 75
Ice Made by Machinery, 187
Image Viewed Through Convex Lens, 215
Intoxication, Prevention of, 257
Iron, Manufacture of, 243
Kettle Singing, Cause of, 271
Kaleidoscope, 285
Lap and Lead in a Steam Engine, 117
Light, Aberration of, 75
,, Intensity Decrease with Distance, 173
Light Producing Photographic Pictures, 285
Lithographic Printing, 327
"Manna" Precipitated from the Sky, 257
Mars Seen to Best Advantage, 215
Matter, Four Known States, 145
Mercury for Barometers & Thermometers, 341
Metals Dissolved, 159
Mining, How Deep to Descend by, 117
Molecules of Matter, 61
Moon Crescent-Shaped? Why is the New, 103
Moon's Influence on Weights, 33
North Pole, 117
Oil on Heavy Seas, 89
Ophthalmoscope, 225
Optical Opacity, 5
Optical Delusions, 229
Palpitation of the Heart, 355
Polarised Heat, 5
Pole Star, 61
Power Producing, 285
Protoplasm, 173
Pulse Beats, Register, 299
Parkinge's Figures, 313
Quicksands, 244
Rain, Calm Troubled Water, 117
Rain-Drops, Globular, 187
Rain, Greatest Quantity Fall, 160
Rifle Bullet Diverged, 117
Sea, Black Colour, Forerunner of a Storm, 131
Seasons, Change of, 299
Seconds, Pendulum, 75
Ships, How Far can they be Seen at Sea? 103
Sight, Long and Short, Remedied, 187
Smoke, To Avoid, 145
Solar System Moving through Space, 34
Space of Four Dimensions, 159
Spectroscope Applied in Meteorology, 103
Spontaneous Combustion, 271
Spectacles, Pebble and Glass, 327
Soda Water Counteract Effects of Alcoholic Liquors, 341
Spectral Forms before Eyes in Illness, 115
Stars, Fixed, 5
Stars, Brightness of, 5
Static and Galvanic Electricity, 271
Steam Engines—Points of the Compass, 89
Survey of a Country, 355
Snowflakes Under Microscope, 327
Snake, Venom of, 341
Sun, Rotation of the, 33
Sun Appearing to Lose Circular Form, 89
,, Drawing Water, 89
,, Brightness of, 131
,, is Not Fixed in Space, 187
,, in Motion Towards Hercules, 285
Summer Hotter in Southern than Northern Hemisphere, 215
Teeth and Bones, Difference Between, 341
Temperature Endured by Human Frame, 47
Trade Winds, 313
Valley of Death, 257
Ventriloquists, 215
Venus, Transit of, 19
Water Purified for Drinking, 159
,, Changed when it is Boiled, 244
,, Apparently Turned into Blood by Aquatic Animal, 257
Water Run Up Hill, 299
,, Impurities in, 313
Weighing Operations and Influence of Earth's Rotations, 19
Will-o'-the-Wisp, 47
Wire, Finest Metal Made, 76
Writing, Light over Left Shoulder, 341

SIFTINGS OF THE STUDY, 25, 41, 80, 90, 110, 136, 275, 331, 346, 362
A Plunge into Space, 275
Agricultural Seasons, Practical Observations on, 332
Animal Coloration, 110
"Cassell's Storehouse of General Information," 346
Digestion and Diet, 331
Electrical Engineering as a Profession, 331
Farm-yard Manure, 90
Fifteen Months in the Moon, 331
First Year of Scientific Knowledge, 136
Glimpses into Nature's Secrets, 41
Keep Your Mouth Shut, 362
Light and Heat, 136
Minimum Wage, 331
My Experiences as an Executioner, 25
Modern Science in Bible Lands, 331
"Nuttall's Standard Dictionary," 346
Physiography, Elementary, 332
Sea-Sickness, 331
Stray Studies from England and Italy, 346
Textbook of Agricultural Entomology, 362
"The Visible To Be," a Story of Hand Reading, 362
Year Book of Science, The, 80

SOCIAL SCIENCE, 26, 40, 54, 69, 82, 96, 110, 124, 139, 152, 180, 194, 208 251, 265, 279, 293, 307, 321, 334, 348, 363
Circumstantial Evidence, 110
Common Sense Lacked, 307
Cookery Civilises, How, 222
Education, What Does Not Do, 251
Excellence, The Price of, 139
Fussy Folk, 26
Give and Take, 279
How Heredity Hinders and Helps, 40
Is Celibacy a Failure? 12
Living for Ever, 334
Love, The Ridiculous Side of, 69
Moods, Our, 152
Motherhood, 237
Over-Sensitiveness, 348
Peculiarities—Permissible and Otherwise, 96
Political Bigotry, 163
Reform and Reformers, 54
Social Reform, 363
Social Sin, A, 321
Specialism and Success, 83
The Coming Woman,
Time and Timekeeping, 208
Wanted—A New Enthusiasm, 293
Wanton Waste, 265
Women and Women, 124
,, ,, 194

T.

Tea—Digestible and Otherwise, 120
Theory, The Use of, 291
Thought Transference, A Theory of, 147, 161
Throat, To Strengthen the, 363
Thunderbolts, Jove's, 315
Tides, Yearly, 146
Time Measured by Incense, 332
Tortoises, Giant, 53
Torpedoes, Detecting, 167
Tobacco Kills the Chameleon, 364
Trees for the Streets, 62

V.

Vision, The Delicacy of, 291
,, The Philosophy of, 52

W.

Water and Air Barometers, 165
,, Novel Way to Boil, 300
Watches, About, 246
Waves of Water, 203
Wild Horses and the Wild West, 162
Women be Educated? Should, 63, 79
World, The End of the, 65
Worlds, Habitable, 109
Worms, Wiping Out, 317
Wreck, A Singular, 137

Y.

Youth, Perpetuating, 364

SCIENCE SIFTINGS
CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*; 3 *months,* 1*s.* 9*d.*

Advertisement Offices: 168, Fleet Street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

A SPEAKING FACT.

Messrs. EMDIN & TOD, Chartered Accountants, of 56, Coleman Street, London, E.C., certify that the Circulation of "SCIENCE SIFTINGS" is

20,387 COPIES WEEKLY.

Since this Certificate was issued, the Circulation has increased by over 1,000 Copies Weekly.

LONDON: SATURDAY, APRIL 23, 1892.

SCIENCE NEWS AND NOTES.

"The strength of all sciences, which consisteth in their harmony, each supporting the other, is as the strength of the old man's faggot in the band; for were it not better that a man in a fair room to set up one great light, or branching candlestick of lights, than to go about with a small watch-candle into every corner?"

—BACON.

Warmth as a Factor of Health

is the least recognised of any principle by the lay mind. Its importance in the management of disease, however, should alone prove what significance it bears to our well-being. A person in a very warm room, without any other treatment, will be safer with a disease than if he were in a cold room, with the best possible treatment otherwise. Again, a person seized, as patients usually are, with a chill, or with headache, or with general aching of the body—the usual initial symptoms—is liable to the greatest danger unless he immediately seeks the protection of warmth. The temperature of a sick-room should, therefore, receive the first consideration, and need it be said that the temperature of an ordinary living-room is of equal vital importance? Physicians tell us the proper temperature of a sick-room should be from 65 to 70 degrees Fahr., and the heat should not go much below or much above these points. Abundance of fresh air and sunshine is the rule in all cases, except where the order of the physician prohibits the light. There is far more danger of the patient becoming enervated by close, foul air than there is from ventilation. An open fire is another necessity to the proper ventilation of a sick-room, and an eminent authority on this subject says: "I do not consider any room suitable for a patient to occupy during a prolonged illness where there is not an open fire burning on the hearth, in order to secure proper ventilation." A closed stove will not serve any such purpose, on the contrary, it throws out a dry heat which can only be partly counteracted by keeping boiling water on the stove. It does not solve in any way the problem of ventilation. In this connection we may mention that one of the best methods of removing odours is to take a shovel of burning coals, sprinkle it with coffee, and pass it round the room.

Insanity may be Brought About

by a variety of causes, and among these "surroundings" take a prominent position, if we may rely on Dr. Savage, who protests against the acceptance of the notion, that nearly all insanity is the outcome of direct neurotic inheritance. The influence of heredity is not denied or minimised, but the great importance of environment is insisted upon. To quote the words of Dr. Savage: "We are what we are in mind and body, to a great extent, as organic results of our forefathers; but that we are no longer naked savages is some evidence that progress and development in the individual and the race may take place as the result of changing surroundings." There can be no two opinions as to the encouragement to be got from such a view. A too great insistence upon heredity as the determining cause of insanity must land us in a hopeless pessimism as regards treatment; whereas a recognition of the influence of surroundings is the first step towards the construction of a reasonable and efficacious system of therapeutics. The author also cites many examples of hallucinations and delusions which are suggested by surroundings; and while all will not be inclined to accept his dictum that disorder of function may lead to disease of tissue, there will be few who will not share his opinion as to the efficacy of restful, pleasant surroundings in the treatment of mental disorder, as compared with the virtues of "medicine out of a bottle."

The Importance of Electricity

for purposes of life and death is daily becoming more manifest. Growing vegetables at an abnormal rate, turning day into night, cattle-slaughtering, electrocuting, are a few among its various uses, to which we are gradually becoming accustomed, and even the method suggested by an eminent electrician of annihilating warships, and referred to in our last issue, was not so very astonishing, but we must confess we were hardly prepared for the last announcement that reaches us from New York. It is to the effect that General Serrell has completed a mysterious invention, by means of which the enemy's ships can be kept outside a harbour, beyond the range of guns, so that she cannot fire upon the place defended. It is done by electricity and by very simple machinery. The inventor of the device claims that it is applicable to the protection of all the sea-coast cities in the United States and Europe. In its application to New York, it is so devised, the inventor claims, that if a single ship, or fleet of any number of vessels, attempted to enter the harbour, each ship could be struck a blow equal to 50,000 foot tons, and the blow would come from overhead, out of the air, as the ship crossed the six and a half fathom line in the outer bay, 14 miles in a straight line from the City Hall at New York. The blow is to come vertically, and is to strike upon the part of the ship where it will do the most permanent harm. Twenty

can be struck in 10 seconds of time. Several army officers and naval experts have investigated the method, and say that the blow can certainly be struck within a foot or two of the point intended. General Edward W. Serrell, the inventor of this electrical system of auxiliary harbour defences, was, during the civil war, chief engineer of the department of the South, United States Army; he is the inventor of the hydraulic vertical gun lift, for Barbette guns; he also planned and personally superintended the construction of the world-renowned "Swamp Angel" batteries during General Gilmore's seige of Charleston.

The Ethics of Chastisement

are dealt with in a very interesting manner, *apropos* of the Montague manslaughter case, by our contemporary the *Lancet*. Position and education afford no sufficient guarantees for moral goodness. The inner nature, in spite of these external influences, may remain hard and passionate, and the chastisements which have their origin there will be like in character. The ethics of punishment were clearly and briefly summarised by the Solicitor-General in his speech on this occasion, as allowing a "right of giving chastisement (to children) for their moral culture, but the exercise of it must be reasonable, having regard to the age and health of the child." This will be generally accepted as a fair statement of the matter. A parent's will, fancy, or feeling has little to do with it, and indeed severity should not be entirely shunned, if only it be exercised with reason. It is the moral culture which gives to the whole system its keynote. For its fittest and most fruitful method we must rely upon educative more than upon punitive measures. An understanding of the highest moral rule, quite apart from mere maxims of expediency, with a zeal for improving the character, inspired and guided by the great moderating force of love involved, or if this be lacking, as occasionally happens, a sense of duty, instructed by dispassionate wisdom, furnish us with the means of truest success. Thus viewing the matter we recognise a reason for patience, and may fairly hope that the exhibition of its power in trial will prove attractive to those we teach, and will justify and impress on their minds the occasional use of measured and resolute chastisement. Children are very observant, however, and will immediately notice if the chastisement be inflicted in the heat of passion; therefore, we should wait until all anger has subsided before meting out punishment of any description. It will be more effective, and less likely to be brutal.

The Investigation of Clouds

from the summit of the Rigi and Pilatus has recently engaged the attention of Mr. John Aitken, the well-known meteorological investigator, to whom we are indebted for the discovery of several fundamental facts in connection with the formation of fogs and dew. He now finds, as in former observations, that fog is intimately dependent on the presence of dust particles in the air, each of the invisible granules forming the nucleus of a tiny head of water, these vesicles constituting in the aggregate clouds, mists, and their kindred. At elevated situations the air is comparatively free from dust, while lower down it is full of it. But while clouds are passing over a peak the number of particles varies considerably. This, he discovers by a series of carefully compiled data, is due to the fact that the air entering into the clouds has forced itself up from the valley below. Hence the mountain air is pure or impure in exact accordance with the amount of the lower current which has reached it. When the cloud vanishes, the ether resumes its old composition.

Another Curious Fact

just discovered by the same indefatigable observer is that the moment a cloud forms, it begins to discharge its contents in the shape of a steady shower of minute drops. These drops are not capable of being appreciated by the unassisted senses; but by the "fog counter," an instrument of Mr. Aitken's invention, the exact number falling on a given space can be readily noted. What is still more curious is that, though the air is in such circumstances saturated with damp, seats, stones, and other large objects near the earth are perfectly dry, the drops being evaporated by the radiant heat of the ground; but a pin's head or other small object, not offering the same area, is in these circumstances often covered with a minute globule of water. The fact of a cloud thus beginning to rain small drops whenever it is formed, may account for the disappearance of these vaporous masses by gradual exhaustion, without any change in the wind or temperature.

A Believer in Evolution,

who hails from Italy, imagines that he has made the discovery that St. Augustine's theory of the creation was in reality similar in many respects to Darwin's. That there should be some resemblance is not surprising, for there is nothing in the latter to interfere with any creed on the question of a first cause, dealing, as it does, only with the circumstances attending subsequent development. Signor Fogazzaro, who claims to have made the discovery, has written a book on the reconcilement of science with religion, in which he attacks the author of a prize essay on the same subject, dwelling upon the differences instead of the points of agreement between St. Augustine and Darwin. The discussion is not of very great importance, for in nearly every age the Mosaic account has been freely handled, even by the orthodox, and nobody is now called upon to accept it as literally true. Geology dealt it a more severe blow than even evolution has done.

Physiognomy

has ever been an interesting study. It is indeed one of the oldest sciences, and it is certain that it was carefully studied in ancient Egypt and India, and in China to-day the rules practised by legal officers for judging the countenances of criminals have come down from very early times. The oldest extant writings on the subject are those of Aristotle; but he was not the first, since in his work he refers to others who preceded him in that line. He was followed by Theophrastus, who wrote a book, entitled "Characters," containing thirty chapters, said to have been illustrated with portraits, and if this statement is true, this was probably the first book with illustrated pictures. Many authors followed, whose names are more or less familiar: Polemo, Adamantius, Giovani Jugegneri, Albertus Magnus, Pietro Montagnani—so many, in fact, that one authority gave a list of forty-one authors who wrote on physiognomy and expression. The chief authors of modern times were: Lavater, who made physiognomy his life study; Camper, a Dutch anatomist, who wrote on comparative physiognomy of men and animals; Gall, Spurzheim, and Darwin, the last of whom, in his book, "The Expression of Emotions in Men and Animals," made a contribution of considerable value to the subject.

The Cardinal Points Without a Compass

may be told by country dwellers by the following simple observations:—The side of a tree on which most of the moss is found is the north. If the tree be exposed to the sun, its heaviest and longest limbs will be on the south side.

The darker side of a stone which the sun strikes is the south, and the bulk of the moss growing on the stone, if any be found, is on the opposite, or north side.

Strains in Bridges

are a matter that always exercise the ingenuity of our engineers, and they will, therefore, be interested to learn of the invention of a clever apparatus for measuring strains both in iron and steel bridges, by M. De Chatelier, a French civil engineer. Two brackets are attached to the member which is to be tested, one bracket carrying a lathe centre, while in the other slides a short steel rod pointed at both ends. One of these ends presses against the flexible diaphragm of a water chamber, connected with an open tube in which the water flows when expelled from the chamber. On the other end, and on the lathe centre on the bracket first mentioned a bar is supported, the arrangement being such that any extension of the bridge member causes a motion of the diaphragm, and is shown on a highly magnified scale by the fall of the water in the tube. Successful measurements have been made between points only eight inches apart.

The Bed of the Atlantic,

we are told, on the authority of a geographical writer, would appear, if it were drained, as a vast undulating plain, with a middle plateau parallel to the North American coast, and another platean connecting this central one with North-eastern South America. The Atlantic is thus divided into three great basins. The tops of the sea plateaus are two miles below a sailing ship, and the deepest parts of the basins almost five miles. These plateaus are whitened for thousands of miles by a minute species of creamy shell which cover their sides like snowbanks. In the deepest parts the sea bottom is red in colour, strewn with volcanoes and meteoric particles and the deeply incrusted bones of whales, sharks, and other sea monsters. In the black and silent waters of the abysses, lighted only by phosphorescent animals, vegetable life is nearly absent, while the scanty animal life consists of a few strange species which only in earlier geological ages can have been common near the surface.

Many Inventions

are nothing more than re-inventions. An instance of this is found in the recent discovery respecting the steam engine. To the older and observant engineers and mechanics, all the world over, the phenomenon of re-invention has become familiar, and to them many of the new inventions, so called, brought out from time to time bear the stamp of old acquaintanceship. There is, in fact a large class of devices which are repeatedly invented by people widely separated, both in time and distance, and it seems, indeed, but natural that men of the same race and of similar minds should choose similar means for producing certain results. Almost anyone having much to do with inventions and patents will recollect instances where inventors have independently accomplished essentially the same results, and many who will regularly look through the Official Gazette will frequently find patents granted for things to him old and well known. Nor is this at all strange. The older workshops are many of them literally stored with ingenious, special contrivances of more or less utility, the accumulation of decades of active and ever-changing business, made by many men for many purposes, and locally so well known that a description would seem superfluous and a patent ridiculous. And yet a multitude of these things may be, and many are, in some far-off locality, re-discovered and presented to the Patent Office, and the claims are allowed without objection.

The Trackless Ocean

is said to be a misnomer in these modern days. The routes taken by vessels, under present conditions, even between extremely distant points, will coincide so nearly as scarcely to show at any point a divergence of fifty miles. A sailing vessel, taking what is called the southern route from Liverpool to New York, would sail about 4,500 miles to cover a direct distance of less than 3,000 miles, yet would in all that devious journey follow a path well understood and established in the Sailing Directions. Science has well served mankind in thus overcoming the mystery of the ocean waste ; but, even so, we cannot perceive the unfitness of the word "trackless" as customarily used in this connection. Wherever else man journeys, he beats a path or leaves a trail, and the next comer may be guided by the print of his foot or the mark of his wheels. That is a track, as commonly understood. But when a vessel cuts her way across the main, her course is "writ in water," and she makes no track save her fast vanishing wake. Men have sought out devices, it is true, by which her path may be again traced with exactness and certainty, and may be implicitly followed. But the tract is only on paper after all ; and he who in mid-ocean, his eye assuring him of the fact, speaks of it as trackless, is not guilty, we submit, even of poetic license.

An Artificial Aurora

and "molecular bombardment" may be shown by a very simple little experiment, which consists in rubbing an incandescent lamp on the clothing, or on paper, leather. sheet rubber, or tin foil, when the bulb will become filled with light ; if you stop it grows dark. If touched with the finger the filament and the interior will be a bright glow lasting from one to three seconds ; if touched again, it is repeated ; by drumming or drawing the finger slowly over the glass the light is quite continuous. If rubbed on newspaper in an absolutely dark room, the larger letters can be read at a distance of two or three inches. Fan the bulb with sheet rubber eight or ten inches away, but do not touch the glass. It will light the same quite bright if the fanning is very rapid. This experiment was recently tried by Mr. T. B. Hemistreet, of New York, and the lamps used were the Edison 16 c.-p., 20 and 22 volts. Most of the miniature lamps will give the light, but not all. It is evidently charged through the glass, as the glow will occur if the metal parts are enveloped in rubber. Everything used should, of course, be dry. It seems to be an electrophorus effect, the discharging only exhausting a section at a time.

Artificial Diamonds

created great excitement at the time that Mr. J. B. Hannay, of Glasgow, was conducting his experiments. The philosopher's stone, it was said, was at length discovered. Then the subject was allowed to drop. Mr. Streeter, in a recently-published book, gives us the sequel. The so-called diamonds were found to crumble to pieces when placed on the wheel for cutting. Worthless as these gems proved to be, they were not obtained without much labour, expense, and, above all, risk to human life. A strange mixture of paraffin and certain metals and minerals were put in a strong wrought-iron tube, and subjected to the heat of a reverberatory furnace. In most of the experiments the tubes exploded, and, in some cases, the assistants were injured in consequence.

GLEANINGS OF THE GLOBE.

According to Herschell, the sun advances though space with a velocity of 154 million miles per annum.

Recently invented wire-drawing mechanism has made it feasible to produce silver and platinum wire so fine as to be thinner than a human hair.

It has recently been proved that when cast and malleable iron are used in the same structure, a galvanic action is set up between them, and the malleable iron is corroded.

Blood travels from the heart through the arteries ordinarily at the rate of about 12 in. per second; its speed through the capillaries is at the rate of $\frac{3}{100}$ of an inch per second.

A discovery of great importance to South Africa is a stone capable of being burned into a natural cement of good quality. The deposit covers 1,000 acres, and varies in thickness from 10 to 20 feet.

There are now 120 women in the Berlin telephone exchanges. It has been decided to employ only women in the future, as their voices are much more audible than men's, owing to the higher pitch.

A "two mouse power" electric motor and battery is being introduced by the Electro Novelty Co., 9, Knapp-street, Boston, The little machine is said to be a perfect working model of the Edison dynamo.

The syllabus of the vacation studies at the University Hall, Edinburgh, has reached us. The course includes science and sociology, combined with many interesting features, that should certainly prove attractive to students.

The Editor of *Pearson's Weekly* is organising a splendid scheme to give London children a breath of fresh air in the coming summer. Those who would like to help the "Fresh Air Fund," either with money or personal service, should write to Mr. C. A. Pearson, Temple Chambers, E.C.

The red colour of the markings on Jupiter is believed by an astronomer to be an indication of their age, the spots of markings (other than the white spots) being dark or black on first appearance, but afterwards becoming red. The great red spot seems to be no exception to the rule.

It is computed that a cubic inch of air taken 4,000 miles above the earth's surface would expand sufficiently to fill a sphere 2,000,000,000 miles in diameter. By the same law, if a well could be dug to the depth of 46 miles, the density of the air at the bottom would be as great as that of quicksilver.

Mr. G. H. Burgess writes from Folkestone that on the 10th of February he saw flying and caught a large white butterfly (*P. Brassicæ*); and on February 25th, he saw a Brimstone (*G. Rhamni*). Although he did not see any tortoiseshells (the commonest butterfly in Folkestone) till the first week in March.

Dew may be derived from moisture from the ground, or from excess of moisture in the air near the earth, coming in contact with vegetable or other substances that have become cold by radiation. Dew falling upon metallic roofs is free from the influence of moisture, and is due to saturation of the air by cooling of both air and metal by nocturnal radiation.

Some experiments in connection with the artificial production of clouds by burning cases of resinous matter were lately made in the Jardin d'Acclimation, Paris, under the auspicies of the Société des Agriculteurs de France, but were only partially successful on account of the wind carrying the clouds away as soon as formed. The promoters of the idea contend, however, that in the absence of the exceptionally unfavourable meteorological conditions which attended the experiments, thick and permanent clouds may be formed for protecting too forward crops against late frosts, and covering military operations.

It is inferred by Prof. Wesendonck, of Berlin, that dustless air, in friction with metals, does not generate electricity. But in the course of some experiments he found that carbonic acid, under like conditions, readily gave a charge, and this was thought to be due to cloud-formation in the gas streaming out of the vessel which had held it in liquid form, the small water particles charging the metal by friction. Further experiment has seemed to confirm this view. Prof. Wesendonck concludes that gaseous carbonic acid is not capable of generating electricity by mechanical friction on metal.

Americanite is the name of a new explosive of great power. The principal ingredient is nitro-glycerine; the other component parts are secret. It is said to be insensible to shock, and explosive at will. It withstands friction, and if ignited with a match, simply burns like a candle. An American expert reporting upon it state that the advantages of being able to use with safety an explosive of a force equal to nitro-glycerine fired from any gun in existence and with terrific effect at a long range, is evident. With so powerful an agent, the problem of coast defence is able almost to resolve itself into one of range, and sea-coast cities may be made comparatively safe with very little expenditure.

Most of the big spiders of the New World are of the sort which build nests with trap-doors, lining a hole dug in the ground with silk, fitting it with a door so artfully made as to hinge, bevelled edge and spring that it is almost impossible to detect the fact that there is an opening, and, in some cases, actually planting seeds on this dainty portal for the purpose of concealing it with growing plants. Some of the largest spiders catch birds, and individuals have been known to capture good-sized fishes, lying in wait for them at the border of a stream.

Look at the Pleiades with the unaided eye and you may see six or seven or a dozen stars; look at it through a three-inch telescope and you may, perhaps, see 300; study it through a telescope for three years, as M. Wolff has done, and map the stars and their places, and you may record 600 to 700 stars on a strange background of nebulous light; expose a sensitive plate for an hour, and more than twice that number are revealed; lengthen the exposure to four hours and you have a picture of 2,326 stars, with a different and more extensive background of nebulosity.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 25.

73.—As to the nature of which of the fixed stars have astronomers obtained the fullest information?

Probably more information is available as to the nature and movements of Sirius than is the case with respect to any of the other stars. The distance from the earth to Sirius is about a million times that which separates us from the sun. Although, as a result of the great distance which separates it from us, the light shed by Sirius is, so far as we are concerned, twenty million times less powerful than that of the sun; yet the actual luminosity of Sirius is, at least, fifty times greater than that of the ruler of our days. The apparent motion of Sirius, although it can only be detected by the aid of the meridian circle, implies a velocity of no less than one thousand miles a minute. Sirius also has a motion of alternate approach to and recession from us, in the line of sight. Sirius has thirteen times the mass of our sun, and is attended by a satellite of rather more than half its own weight. The actual luminosity of the satellite, notwithstanding its enormous size, is only about one hundredth part of that of our sun. This satellite or planet revolves about Sirius in a period of forty-nine years—the radial distance, by which it is separated from the parent star, being no less than thirty-seven times that which intervenes between the earth and the sun.

74.—What is the simplest method by which perfectly dust-free air can be obtained?

The simplest method is to filter the air, by passing it through densely packed cotton-wool. If, however, the presence of a little carbonic acid and moisture is not of importance, the expired air from the lungs may be used. It will be found perfectly dust free.

75.—Is it a fact that optical opacity may result from the superposition of two transparent bodies; and, if so, in what way can this be most simply shown?

A transparent glass bottle, containing nitrate of nickel solution, absorbs the red and violet components of sunlight, and, therefore, appears green by transmission. A similar bottle, filled with chloride of cobalt, appears red. Looking through the two bottles simultaneously, no light whatever can be seen. The blackness results from the absorption by the first bottle of that coloured light to which the second bottle is transparent; and from the absorption in the second of such light as is permitted to traverse the first. A plate of green glass and of very dark red glass will answer for a similar experiment.

76.—How is the relative brightness of stars determined?

The only rational method is to employ a photographic telescope. It has been found best to allow the sensitised plate to "lag" a little, so that a trail and not a single bright spot may be photographed, when stellar photometry is in view. Several plates, sensitised by different standard methods, must be used, in order that due account may be taken selectively of the different kinds of coloured light that are radiated by the stars. Vision fails badly in work of this kind, because the sensitiveness of human eyes for differently coloured light varies in a very irregular manner. It may be of interest to add that Aldebaran and the pole star correspond very closely to the conventional standards of brightness for, respectively, stars of the first and second magnitude.

77.—Why does the electric arc light appear to give a bluer colour than sunlight?

As the proportion of the blue rays emitted increases with the temperature of an incandescent body, and as the surface of the sun possesses a higher temperature than any that has yet been artificially produced, it would be unreasonable to suppose that true sunlight is not considerably bluer than the radiations of any similiar artificial source of light. It is believed that, as a matter of fact, the surface of the sun emits a distinctly blue light, but that this is modified, in the first place, by the atmosphere of the sun himself, and in the second place, by that with which the earth is surrounded. In this way the sun's light, although originally much the bluer of the two, may be made to appear quite yellowish, by comparison with an electric arc at a distance of a few feet only. There can be no doubt, however, that an unwarrantable prejudice against the arc has been engendered by the fact that it is often viewed in comparison with gaslight—an illuminant of markedly yellow tinge. It has been suggested that, with a view to softening the tone of the arc light, the carbon points should be surrounded by some flourescent medium.

78.—What is polarised heat?

Heat in the form of temperature is simply molecular motion. In the radiant condition it is, however, closely analogous to light, and consists of vibrations in the luminiferous ether, taking place in many different directions, in a plane at right angles to the path in which radiation takes place. Plane polarisation is the revolution of a bundle of "rays" vibrating in different directions, into nearly consecutive bundles, each limited to vibrations taking place in one plane. The two bundles of waves vibrate at right angles to one another, and, when a crystal of tourmaline is the polarising medium, one of them is quenched—*i.e.*, absorbed. The polarisation of heat has not, as yet, been applied to any useful purpose except to the demonstration of the identity of different kinds of radiation in everything except in period.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

85.—How long is it supposed that the earth's supply of coal will last?

86.—How is the speed of rotation of the sun determined?

87.—In what way should eggs be cooked in order that they may be most digestible?

88.—What amount of heat would be produced by the collision of two cannon balls moving in contrary directions?

89.—What influence does the moon have on the weights of small terrestrial objects?

90.—How fast is the solar system moving through space?

A STAR THAT NO MAN HAS SEEN.

The many wonderful discoveries in astronomy, recently made by the aid of photography, have seemed to leave the older methods of astronomical investigation far in the rear. But just now Mr. S. C. Chandler, of Boston, has made, what what may be called, a discovery by the aid of mathematical methods, recalling the achievement of Levereier and Adams in the detection of Neptune fifty years ago. There is in the northern sky, he informs the *New York Sun*, a star known as Algol, which the sharp-sighted Arabs, who discovered its variations in light, called the demon star. Every two days twenty hours and forty-nine minutes this star suddenly begins to fade, and continues to grow fainter for three or four hours, at the end of which it has sunk from the second to nearly the fourth magnitnde. After remaining thus for a few minutes it begins to brighten, and in the course of three or four hours more regains its former brilliancy. Within the past few years it has been discovered that there is a huge dark body revolving around Algol at a distance of some three million miles, and to this phenomenon the variations in Algol's light are due. At regular intervals this dark companion star comes into the line of sight between Algol and the earth, and thus partially eclipses Algol, cutting off, perhaps, five-sixths of its light.

These stars, Algol and its strange non-luminous comrade, are of great size, Algol itself being more than eleven hundred thousand miles in diameter, while the diameter of the dark body that circles around it is eight hundred and forty thousand miles.

Mr. Chandler, meditating on certain irregularities in the motions of Algol and its companion, suspected that they might be due to the presence of another invisible star in their immediate neighbourhood. He carefully compared the observations back to the time of Goodricke, more than a hundred years ago, and pursuing a mathematical method similar to that which resulted in the discovery of Neptune, through the effect of its attraction on Uranus, he arrived at the conclusion that such another star must actually exist. According to his conclusion this mysterious body is far more massive than either Algol or its companion, but does not give forth any perceptible light, and it forms a centre of attraction around which both of the other stars revolve in a nearly circular orbit, in a period of one hundred and thirty years. Mr. Chandler's theory seems to fit in well with the observed irregularities of Algol. He remarks, moreover, that there are several other stars known to astronomers to be variable, which evidently have one or more dark companions like those of Algol.

It is natural to inquire what is the nature of these mysterious dark bodies existing in the neighbourhood of bright stars, comparable in brilliancy with our own sun, and evidently obeying the same law of gravitation that prevails in our solar system. The primary distinction between a sun and a planet is that the former glows with a brilliant light of its own, while the planet, having been encrusted with a solid and opaque shell, only shines by the reflected light which it receives from its sun. The dark companion of Algol may then be regarded as in the planetary condition, at least, so far as the question of luminosity is concerned. But they differ widely from any of the planets of our system in their great size, as compared with the sun, in whose neighbourhood they circle. That companion of Algol, which by its eclipsing effect produces the variation in the light of the star, is not very far inferior in size to its bright comrade, while the greater dark body, whose existence seems to be demonstrated by Mr. Chandler's investigations, greatly exceeds them both in mass. Here, then, if we choose to adopt the idea that this great invisible orb, around which Algol revolves, is a planet in our sense of the word, we have a world which is the centre of motion for the sun that illuminates it. This is going back to the old pre-Copernican idea of the earth as the centre of the solar system, having the sun as its satellite. Such a system seems unnatural, if not impossible, because the ordinary laws of the radiation of heat require that a large body, other things being equal, should cool down from the solar to the planetary condition later than a smaller body. But it would seem that in the Algol system, for some reason yet to be discovered, the most massive member of the system has parted with its light and heat far earlier than one of the satellites revolving around it.

If it should prove to be true, as Mr. Chandler suggests, that there are other, and perhaps many other, systems similar to that of Algol, then we shall simply have additional evidence of the great variety that exists in the arrangements of the stellar universe. There really is no reason why we should take our own solar system as an invariable type to which all the other systems throughout space must correspond. It might be suggested that in the case of such a system as that of Algol, all the bodies belonging to it have long since become extinct through the operation of those laws of cosmical evolution which seem to be manifested in the universe at large, as well as in our own planetary system, and that through some such cause as a collision, one of the minor bodies of the system has again been brought to a luminous condition.

But there is no end of speculation when we try to interpret the wonderful discoveries with which the astronomy of our time is continually surprising the world.

Prizes for Amateur Photographers.

We include among our readers so many who practise photography, both for pleasure and scientific research, that we have decided to start a series of competitions, which we shall continue through the season f the interest is maintained. The first competition will consist of

Six Prizes.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co.) for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A camera for making enlargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a separate coupon, firmly attached thereto.

The last day for sending in photographs, slides, or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet Street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday, June 28th, 1892.

EVOLUTION AND PHYSICAL DEVELOPMENT.

The public is beginning to realise that the physique is something more than a matter of great interest to scientific observers; that it is, in fact, a subject of practical importance to each one of us. It is, doubtless, pretty generally known that, broadly speaking, the difference in the physique of man in the highest centres of civilisation and that of man in a savage—or, to be more accurate, in a lower state of civilisation—is, with the exception of parts of the brain, greatly in the favour of the latter; that is to say, we have obtained the advantages of civilisation, with the above exception, at the expense of the body; and inasmuch as we are continuously making further advances in knowledge, and applying that knowledge in the ordinary routine of daily life, the tendency of this progress still is to the further detriment of the body. This is not an agreeable fact to contemplate, and the reminder that the "fittest" will survive neither affords us compensation for the injury, nor points out the means by which it may be obviated; for the class of the fittest for the circumstances of a generation ago is not the class of the fittest for the circumstances of to-day, and the class of the fittest for the circumstances of to-day will not be the class of the fittest for the circumstances of the next generation. Hence this most important question arises, How can we obtain for civilised man a physique equal, at least, to that of man in a lower state of civilisation, and make the further advances of knowledge tend to the advantage of the body? The answer to this question, we are told by Mr. Godfrey Hambleton, lies in the ascertainment of the effects of the conditions of our habits and surroundings upon the body, and the application of that knowledge to our own protection and advantage.

Nearly twenty years ago he commenced the investigation of this subject, and the result of that research he laid before the British Association in 1886-87. Then he showed that the size and shape of the chest varied as he varied the conditions to which it was subjected. For example, when he submitted a chest to conditions that tended to develop it, that chest increased in size, and its form or type changed accordingly. When he submitted a chest to conditions that tended to decrease it, that chest decreased in size, and changed its form or type accordingly. He ascertained that those results were absolutely invariable, and could be carried out within such wide limits that, on the one extreme, they embraced the class of the non-survivors, through consumption, and on the other, the finest physique of the class of the survivors or fittest. He also pointed out the fact that we had an example of one type of chest forming a series of types that have varied precisely as the conditions to which it was subjected have varied. At birth the male child of all classes has the same type of chest, but at maturity he has that of the class to which he belongs. We have the same relationship between conditions and type; on the one hand, in those who use wind instruments, or who by their occupations require to greatly use their lungs; and on the other, in those who spend a great portion of their time in a stooping position, or who compress their chests either by the instrument they use in their work or by a corset. The great development of the muscles of the trained athlete, and the wasted muscles of the paralytic, are due to the conditions of their use and disuse respectively. We know that the head has been altered in shape by direct pressure, and that the greater size and the more complicated arrangement of the brain of a European to that of an aborigine of Australia is produced by the greater mental training of the former. The difference between the hands and fingers of a pianist, and those of a man accustomed to lift heavy weights, is produced by the conditions of their occupations. Upon the presence and absence respectively of shoes depends the difference in the size and shape of the foot of a Chinese lady and that of a woman in the uncivilised state. The colour and thickness of the skin vary according to the conditions to which it is subjected, and there is the same relationship between the size and shape of each part of the body and the conditions to which it is subjected. Therefore, the type of man after birth is solely produced by the conditions to which he is subjected. Hence the formation of race by man's continuance under the same conditions, and its subsequent divisions into sub-races and families by his migrations into new conditions and the minor differences therein. Hence also the difference between the same species of animals under the conditions of nature and of domestication, between the products of the same seeds when sown in different localities, between the same plants when placed under different conditions, and the return of man, animal, or plant to former types when subjected to the conditions that produce that type.

It would be difficult to overestimate the immense importance of the facts just briefly referred to. They prove to us, beyond the possibility of a doubt, that man is what his habits and surroundings make him; that he is a member of the class of the survivors or fittest because the conditions, as a whole, of his habits and surroundings are favourable to him; that he is a member of the class of the non-survivors, those who prematurely disappear, because conditions, as a whole, of his habits and surroundings are unfavourable to him; and that he can so order his habits and surroundings that they shall tend to his advantage. A great work and a great future lie straight before us. We have to ascertain the tendencies of all the conditions to which our bodies are subjected by our habits and environment, in order to apply that knowledge to our own protection and advantage. And that is the sphere of true physical development.

An important step towards the attainment of this great object has been taken by the formation of the Polytechnic Physical Development Society, of which Mr. Hambleton is president, to apply the principles of physical development in the ordinary routine of daily life. Perhaps the best way to explain the practical work of the society is to describe what happens to a new member on joining it. He is placed in an erect position, his shoulders are brought well back, and his clothing so loosened over the whole of the chest, that it permits full and free movement. It is found in nearly every case the clothing is from one to two inches or more too tight. Then he is shown the simple movements that are necessary to throw the weight of the shoulders on the spine, he is taught to inhale and exhale deeply through the nose, and to use the spirometer and manometer. The conditions of his habits and surroundings tending either to his injury or to his advantage are explained to him. He is told to avoid those that tend to act injuriously, and where that is not possible or practicable, to ascertain their amount and to counteract their effects, and to place himself under those that tend to his advantage. His careful attention is requested to these conditions, and those that have to be avoided are emphasised. The habit of stooping, positions that cramp or impede the full and free movement of the chest, or a faulty carriage of the body, are very injurious. Habits that tend to the disuse of the muscles or to their excessive use are to be avoided. Breathing through the

mouth, or breathing air that has a temperature much above that of the external air, or that is impure, or that contains dust, is very injurious. Wearing tight-fitting or too heavy clothes, braces, corsets, or shoes with high heels and narrow toes, tends to impede the full and free movement of the body and is injurious. And whatever of his habits or surroundings tends to act injuriously or to produce such acts must be avoided.

The new comer is told to acquire the habit of holding the body erect, the shoulders back, and the chest well forward; to breathe through the nose, and to take deep inspirations followed by full expirations several times daily; to develop the muscles, especially of the chest, by gymnastic exercises; to go in for the daily tub or swimming; and to have his clothes made quite loose at full inspiration, and to see that they do not impede either by their weight or shape the free movement of the body. He is advised to live in rooms that are in free and direct communication with the external air night and day, summer and winter, and to take care that their temperature is not too high; to spend as much time as possible daily in the open air, and to maintain the temperature by muscular exercise. It is pointed out to him that walking is a most healthy exercise, and that broad toes and low heels tend to promote it. He is told to practise singing, and to take advantage of some form or other of athletics whenever the opportunity presents itself. And whatever of his habits or surroundings tends to his advantage, or to produce acts having that tendency, must be adopted.

We are, all of us, at times subjected to unfavourable conditions that we cannot, under present circumstances, avoid. For example, it would be difficult to be present at any public meeting, in a large building, without having to inhale both impure and overheated air. But when we have obtained a certain amount of physical development, a few deep inspirations followed by full expirations in the open air will be sufficient to counteract that. Again, the occupation or business in which we may be engaged, may necessitate a somewhat cramped position of the chest, but on leaving, a trained man will soon obtain compensation for that by holding the body erect and taking proper breathing exercise. The main point is to ascertain our unavoidable injurious conditions, and to arrange the other conditions so that the tendency of the whole is decidedly in our favour, and it will take a well-developed man but little trouble to accomplish that.

HOW STEAM ENGINES ARE MADE.

According to the description of a young lady, the following process is gone through in the manufacture of a steam engine. "You pour a lot of sand into a box, and throw a lot of old stoves and things into a fire, and empty the molten stream into a hole in the sand, and the men all yell, and it's awfully dirty and smoky. And then you pour it out and let it cool and pound it; and then you put it in a thing that goes round, and try to break it; then you screw it to a thing that goes back and forth, that you can ride on, and that scrapes it and it squeaks; then you put it in a thing that bores holes into it. Then you screw it together and paint it, and put steam in it, and it goes awfully; and they take it up in the drafting room and draw a picture of it, and make one of wood just like it. And oh, I forgot—they have to make a boiler. One man gets inside and one gets outside, and pound away just terribly; and then they tie it to the other thing—and oh, you just ought to see it go!"

ECCENTRIC INVENTIONS.

While many of the greatest inventions have been so simple in construction as to make us wonder why they had never been thought of before, it is equally true that other ideas have proved impractical in direct disproportion to their plausibility. If all the working models devised by eccentric inventors could be gathered together what fine playthings they would make for the inmates of insane asylums.

Some years ago a man named Creighton conceived the idea of walking on the water. His theory seemed beautiful, and nothing could convince him of its worthlessness until he gave it a practical test and nearly lost his life through his folly. He took a pair of circular life preservers, bent them until they somewhat resembled a boat in shape, and made a network support for his feet on the principle of the snow shoe. The test was quietly made one evening in a harbour. Stepping out of a boat it was with the greatest difficulty that Creighton managed to assume an erect position. The tide carried him for a few yards, but the moment he attempted to walk he lost his balance. Thanks to the cork life-preservers, for once in his life his feet were lighter than his head, and he was soon floating upright in the water. When he suddenly disappeared and his friends saw nothing of him but his wonderful walking boots, it was some time before they could control their laughter and realise the danger the man was in. The one test was enough for Creighton, and whenever he ventured on the domain of Neptune after that a boat was good enough for him. The only one who ever benefited by the idea was the writer of a novel who subsequently provided his hero with a pair of water walking boots, by which he could kill Indians until the fight became too hot and then escape by walking across a convenient river.

Probably the best known of eccentric inventors was Richard Lovell Edgeworth, the father of the famous novelist. Besides being the inventor of an ingenious telegraph apparatus, which was accepted by the Government at the beginning of the century, Edgeworth devised many contrivances of less practical use. A one-wheeled chaise, which he constructed for easy travelling in narrow roads, was looked upon with wonder, and has had many imitators in later years. The vehicle was made fast by shafts to the horse's sides, and was furnished with two weights, or counterpoises, that hung below the shafts. In order to bring the centre of gravity of the whole as low as possible, the seat was not more than two feet from the ground. The footboard was attached to the shafts and turned upon hinges, so that it gave way when it met with any obstacle and warned the driver to lift up his legs. In going through water the legs were kept dry by leathers, which folded up like the sides of bellows.

To win a wager Edgeworth constructed an apparatus by which a man, with the assistance of machinery, could walk faster than any other person who could be produced. The machine consisted of a large hollow wheel, made very light, inside of which, in a barrel six feet in diameter, the man should walk. It was made to roll on planks and on a plane somewhat inclined. The idea was that while the man in the barrel stepped thirty inches, the circumference of the large wheel would revolve five feet on the ground, and carry him along as fast as he could walk. The wager was never decided, thanks to a small boy whose curiosity prompted him to get into the barrel and set the machine going on the top of a hill. Edgeworth had devised a brake to regulate the motion and prevent the machine from running away. Before the boy had gone

very far he no doubt wished he had waited until the brake had been attached, for the wheel went down the hill as if it had been greased. By a miracle the boy's life was saved, for he was thrown out on the road a moment before the barrel rolled down an old chalk pit, where it was smashed beyond repair.

When the subject of elevators to hoist passengers from the street to the L roads was first broached in America, an eccentric inventor came forth with an idea which he thought would solve the problem and make him rich beyond the dreams of avarice. He argued that if you put a pound of lead on one side of a scales and a two pound weight on the other that the weight would come down and the lead would go up. He made a machine like a large pair of well buckets. When a passenger stepped in the bucket resting on the pavement all he had to do was to call through a speaking-tube to the attendant above and tell him how much he weighed. The attendant would then put double the weight into the upper bucket, which would make it drop to the pavement while the passenger would be shot up to the platform. It was a beautiful idea, but it wouldn't work.

It was probably a brother of the above inventor who conceived an idea by means of which he was to make a sailing vessel move rapidly in a dead calm. He first tried it on a small scale with a sailing boat, and the success he met with did not encourage him to follow up the experiment with a five-masted schooner. On a perfectly calm day, after being towed out into mid-stream, he hoisted his sails and essayed to return. As there was no wind, he determined to raise one; not by the old-fashioned way of whistling, but by the aid of a pair of big bellows. In theory the scheme worked like a charm, but fill the sail as he would with the manufactured breeze the boat refused to move, and the inventor's feelings can be better imagined than described when he was forced to pick up an oar and paddle himself back to shore.

A Dr. Pape, spent many years of a long life in an attempt to devise a locomotive engine which would run by steam and lay its own track. While nothing ever came of it, the idea was magnificent, for if it had been successful the whole system of railroad making would have been revolutionised.

TO OUR READERS.

A Two-Guinea Portrait Free.

The Proprietors of "Science Siftings" will present a beautiful porcelain portrait, free of any charge whatsoever, to every reader of the paper who forwards three annual subscriptions of 6s. 6d. each, or six bi-annual subscriptions of 3s. 4d. each. These may be canvassed among friends, and a triple object will be served: the friends will be enlightened, "Science Siftings" will be helped onward, and a free portrait secured by the canvasser:

The liberality of this offer will be appreciated when we state that these portraits cannot be procured in the ordinary course of business under two guineas each. They are artistic portraits, beautifully finished by hand, on porcelain panels, measuring the size of this page (10 inches by 8 inches).

Another Offer.

Our object in making this offer is to cause people to talk about "Science Siftings," and thus to promote the circulation. It will be manifest that we lose money by each portrait. This, however, makes people talk about the portraits, and, hence, about the paper. We will, therefore, send to those readers who cannot induce their friends to subscribe to "Science Siftings," a portrait on receipt of 7s. 6d. to cover the cost of the porcelain panel and postage. The portrait will then be free.

Send a good portrait with the order, and the clearer this is, the better the enlarged porcelain portrait will be.

OXYGEN OR OZONE?

The recent discussion of diseases of the human system as due to the action of microbic agencies has directed attention to the subtle gas called ozone, which has been widely claimed to be a valuable antiseptic and germicide. It is alleged to be especially useful in diseases of the respiratory organs by readily destroying the micro-germs which find their most congenial habitat. It is also stated that methods have been invented for compounding the gas with certain other substances, and that in such combination it is a valuable antiseptic for use in cuts, bruises, ulcers, &c. The latest claim is that this substance can be changed into a gas, and inhaled with remarkable advantage in such diseases as asthma, hay-fever, catarrh, bronchitis, and possibly in pulmonary affections.

The chemists have demonstrated that the mysterious substance termed "ozone" is a form of oxygen, and appears to be equally elementary. From the fact that the latter is only two-thirds the weight of an equal volume of the first, under similar conditions, it is inferred that the molecule of oxygen is made up of two atoms, and the molecule of ozone composed of three of the same kind of atoms. The rearrangement is most readily effected by the electric current, and the lower the temperature at which this is effected, the less quickly does the ozone tend to return to the state of oxygen, which it does naturally, the latter being the most stable form, in a chemical sense. Hence oxygen is changed to ozone by the electric discharges that often accompany storms, but the new formed material soon lapses back to the simpler condition. It is remarkable that only a small part of a given volume of oxygen can be so transmuted by artificial means, and that if the force be applied further the result is an undoing of a portion of the work previously accomplished.

Ozone is chiefly remarkable for its oxidising power, and air charged with it exerts an irritating action upon the organs of respiration. This latter fact has been known for several years, but that the irritation is death to the mircobes which affect the air passages is a new claim. So also is the idea that the best form of administering it as a remedy is in chemical combination with the other element which enters into the composition of water. They unite in the proportion of nearly 16 to 1 by weight and the result has been called the peroxide of hydrogen, the more correct term being "hydrogen dioxide." It is regarded as an oxidation of water, and is produced when water is decomposed by an electric current.

It is understood that this compound is coming into pretty general use in the hospitals as forming an excellent antiseptic spray or wash for wounds and ulcers, but that another ozone compound with glycerine called glyc-ozone is a failure. It is said that the latter when vapourised and inhaled, irritates and inflames the mucous membranes of the bronchial tubes that lead down to the lungs, and thereby defeats any other benefit that might arise from its use. It is believed there is no doubt that its employment is wrong on inflamed throat surfaces, where the microbe germs are committing their ravages. That fact may, however, simply indicate that the best material for combining with the ozone agent has yet to be discovered, leaving the great value of the agent itself undisputed and indisputable.

It is legitimate to infer that ozone is the more active and energetic form of oxygen, that it attacks with greater celerity the substances which have affinities for oxygen, and takes hold of some that have no such affinity within ordinary ranges of temperature. In its application to human disease it may be reasoned as probable that it ministers to the

health of the larger organism by eating up (oxidising) the smaller ones called microbes which feed on the other, and that it is most effective in the air passages because it soon returns to the usual form of oxygen after entering the body. It would thus appear to destroy ferments outside, and to help purify the atmosphere for the use of man, and it has been boldly assumed that without ozone in the air, human beings would soon cease to exist, being quickly destroyed by microbic germs and other products of putrefaction. In fact, a writer in a recent issue of a medical journal takes the ground that much of the sanitary work attributed to oxygen is really that of ozone, that being the life-preserving element, at least for the higher organisms, because it enables them to resist with (some) success the attacks and ravages of micro-germs, and also cleanses and purifies the system from the putrefactive products of those pests.

It would be of great interest to know just how much of this can be substantiated, and how much may be credited to the enthusiasm with which an imaginative writer will deck any new thing that strikes his fancy as worth discoursing about. For if the statements in regard to the influence of ozone on the animal economy be in the main correct, the inquiry opens up a far-reaching question as to the possibilities of ameliorating human ills by the use of appliances already placed in our hands by the labours of scientific investigators. It is not only possible, but practicable to effect a large increase in the quantity of ozone for the use of man in general, or for the particular advantage of the minority who need it as a corrective to faulty surroundings or defective constitution to begin with. Is it desirable to work for such increase? Or will subsequent investigation lead up to the belief that the artificial production of ozone in any of its forms would be like many other much-lauded sanitary agencies, productive of more harm than good.

ANCIENT REMAINS.

Senor F. P. Moreno, who has been investigating some ancient graves in the Argentine Province, Catamarca, has found various objects which are likely to be of considerable importance in the study of American archæology. He has secured 86 human skulls, 400 vases, 420 stone implements 15 copper implements, and 110 objects made of bone The skulls are of two different types, one set resembling those found in the graves at Ancon, Peru, another those of Indians in Chaco and in the south of the Argentine Republic. All are brachycephalic, and many have been artificially distorted. The skulls of the Peruvian type are the later of the two groups. It is evident, however, that before the appearance of the Peruvian element in what is now Catamarca, the population were in a much higher position than the Indians of the present day. They built strong fortresses, like those which are found in Arizona and New Mexico, and the traces of their dwellings indicate a comparatively advanced stage of civilisation. Many of the remains remind Senor Moreno of the Mexicans, others seem to show some affinity between the people and the Chibcha, while others are of a quite peculiar character.

A curious result has followed the introduction of electricity for street-lighting in Orizaba, Mexico. Millions of insects have been attracted from the mountains, and their dead bodies have collected in great heaps about the lamp-posts. Under a hot sun, an unbearable stench has risen from the decaying masses, and fever has broken out among the inhabitants. It has been found necessary to send out wagons every morning to carry away the dead insects.

THE PROBLEM OF TRANS-ATLANTIC TELEPHONY SOLVED.

By Germanicus.

The philosophical society of the neighbouring town of Bladensburg having added to its rooms an electric museum on the style of the "Urama" in Berlin, and wishing to celebrate its opening by a conversazione, had invited me to present on this occasion a paper on the subject, "Is affinity between molecules possible without polarisation?"

On the day appointed I had carefully revised my manuscript and, anticipating a lively informal discussion, I had spent the remaining hours of the afternoon in studying Maxwell's treatise on "Atoms" in the *Encyclopædia Brittanica*, carefully noting down those arguments which seemed to fortify my own views with reference to the subject.

I then hastily dressed, swallowed a glass of strong milk-punch and, lighting a cigar, awaited the carriage, which was to take me to the place of meeting three-quarters of an hour away. In a short time the servant announced the cabman. I entered the vehicle, and soon the monotonous roll of the wheels on the smooth country road enveloped my senses with its soothing influence. I lazily reclined on the soft carriage pillows trying to catch a short rest as a preparation for the evening's work. But it seemed as of no use, although I shut my eyes and tried to banish from my mind the mass of intricate equations through which I had waded for several hours previously.

The carriage seemed to make but slow headway, but presently it stopped and I alighted and entered a new portal to the left of the main entrance which, as I had been informed, led directly to the museum which I meant to inspect before going to the lecture hall. Upon entering, a curious sight greeted my eyes. Large numbers of instruments, such as I had never beheld or heard of, stood on the tables and shelves. A couple of overseers in most outlandish costumes patrolled the floor. Now and then a telephone, provided with a small funnel, would emit a soft song or an orchestral piece, and, most strange of all, the light in the rooms seemed to emanate from large glass tubes distributed along the walls in shapely forms, and which were filled with sunlight glow, although neither filament nor arc carbons were visible.

In a corner of the hall I noticed the inscription "Electric microscope," and entering the small door underneath I suddenly found myself in a very cool grotto, revealing under a dim light the large eyepiece of an enormous looking microscope.

Seated beside the instrument I noticed another one of those strangely clad overseers, who beckoned me to look into the eyepiece. "This," he said (evidently taking me for a visitor from the country desiring to be instructed), is an electric microscope. The object glass consists of a disc of frozen iodide of iron solution surrounded by a coil of wire, through which flows a current of 600 amperes, which the electric furnace in the basement furnishes. The electro-magnetic field produced by this coil in the frozen disc produces a perfect lens effect, but with the necessary parabolic correction for very large magnifying effects. A continuous spray of liquid carbonic acid not only keeps the iodide disc perfect, but also solidifies fluid objects when required.

"Such is the case with the subject you may behold to-night, namely, a part of a section through the new Atlantic conductor for the transmission of speech, of which you, no doubt, have read in the newspapers. It is magnified enormously, so that the molecular structure of the various

parts of the cable are easily discernible."

I had, while he spoke, stepped forward and looked into the eyepiece. At first I could notice but a vast expanse of space like the heavens, and dimly lighted and divided into two principle sections of different very light tints. Gradually, my eye becoming more accustomed, objects in the foreground took more decided forms. The right side of the expanse was of a light pinkish tint, while the larger left portion appeared transparent and almost devoid of colour. As I looked sharper a curious network appeared as if spread in the foreground. In the reddish section this network looked like an immense sponge of extremely fine needle crystals, the pores of the sponge being abnormally large in proportion to the thin structure-forming needles. But there was great regularity of shapes, so that it reminded me partly of a honeycomb, without, however, giving a conception of body or thickness.

The network in front of the larger portion of the expanse, however, consisted really of detached but nearly-touching elongated forms of a compound character. I distinguished in each form three round bubbles, a centre large one and two much smaller ones adhering to the larger on opposite sides. Each bubble consisted of a number of minute balls, exactly alike in size, but differing in size for each bubble.

"The network structure to the right," explained the overseer, "forms part of the conductor and shows the slender needle-shaped molecules of copper, held together end to end by molecular affinity into regular geometrical figures, The compound bubbles to the left are the compound molecules of purified oil, the larger bubbles being carbon molecules, the next size oxygen, and the smallest hydrogen molecules, the two latter being separated by the first.

"In reality the new submarine conductor consists of a tube made of nickel steel, filled with oil and three feet in diameter, through the centre of which, held in place by wooden braces, passes a twisted copper wire conductor one inch in diameter. The steel tube is suspended in the ocean on permanent floats anchored a mile apart, and it stretches from Halifax in Nova Scotia to Valentia in Ireland, at a depth of 75 feet below the surface of the ocean. The theory on which this line was built holds that electricity is a flow of ether through and along a conductor, and that a good conductor has the faculty of attracting and condensing ether within and around itself. The flow of ether produced by a generator of any kind will be held attracted along a conductor, but will drag with itself the surrounding non-condensed ether all along the line. It is, therefore, important that in a first-class line, such as is needed for the transmission of the rapidly vibrating impulses of speech currents, no substance which is termed a good conductor should be in the immediate neighbourhood of the current carrier, because such conducting body would have condensed on its surface a thick layer of ether which would offer a frictional resistance to the flow of ether in and along the current carrier, resulting in a drag or retardation of the current.

"Nothing is more detrimental to the transmission of speech than retardation which obliterates, first, the delicate curves of the consonants; next, the vowel waves, and lastly flattens out into a straight current even the more prominent mere musical undulations of sound. To overcome as much as possible this retardation, it is therefore necessary to surround the conductor with a sufficiently wide area of a medium which does not condense ether and thereby reduce the frictional resistance to the current ; and of all applicable substances, purified oils have the least affinity for ether and do not condense it. To prove to you the existence of ether condensation," continued the overseer, "I will now develop into the microscopic field a powerful electro-magnet distortion and at the same time illuminate it by polarised light from a million candle-power arc light ; look !"

Instantly the vast expanse brightened up perceptibly ; the network of molecules darkened, but between the needles and the compound bubbles there appeared the faint silvery outlines of the ether particles. Round, as tiny soap-bubbles, they were on the extreme left, just touching lightly and barely compressing each other. Passing toward the right they appeared slightly elongated, and in the neighbourhood of and in the spaces between the copper molecules they were pressed together in a dense mass of oblong streaks of silver, giving the effect of a halo along the line of the copper conductor.

"What," inquired I, "would be the result of a rapidly interrupted current on the conductor, as viewed through the microscope ?"

"Take this telephone," said the overseer, "and I will gradually raise the pitch of this rheotome, and when you think the interruptions are rapid enough I will charge the field in the microscope with them with the aid of an inductorium, and you may see for yourself the effect."

I put the telephone up, he turned a switch, and the low rumble of the rheotome reverberated in my ear. Suddenly it ceased ; I felt a shock and saw a light flash.

"Here we are !—Bladensburg !" the cabman shouted.

AN ELEPHANT'S PALATE.

An elephant's digestive functions are very rapid, and the animal, therefore, requires daily a large amount of fodder—600 pounds at least. In its wild state the elephant feeds heartily, but wastefully. It is careful in selecting the few forest trees which it likes for their bark or foliage. But it will tear down branches and leave half of them untouched. It will strip off the bark from other trees and throw away a large portion.

As it is a nocturnal animal, it selects its trees by the senses of touch and smell. Its sense of smell is so delicate that a wild elephant can scent an enemy at a distance of 1,000 yards, and the nerves of its trunk are so sensitive that the smallest substance can be discovered and picked up by its tiny proboscis.

An elephant's palate is very delicate and the animal is whimsical in selecting or rejecting morsels of food. Sir Samuel W. Baker, in his "Wild Beasts and Their Ways," tells an anecdote humorously illustrative of the whims of a tame elephant belonging to the police of Dhubri :—

This elephant was fed with rice and plantains. The stems of the plantains were split and cut into transverse sections 2 feet in length. Three-quarters of a pound of rice was placed within each tube of plantain stem. One day, while the elephant was being fed, a lady offered the animal a small sweet biscuit. It was taken in the trunk and almost immediately thrown on the ground.

The mahout, or driver, thinking that the elephant had behaved rudely, picked up the biscuit and inserted it in a parcel of rice within a plaintain stem. This was placed in the elephant's mouth and at the very first crunch it showed its disgust by spitting out the whole mess. The small biscuit had disgusted the animal and for several minutes it tried by its inserted trunk to rake out every atom from its tongue and throat.

SOCIAL SCIENCE.

IS CELIBACY A FAILURE?

To marry or not to marry? is the question that has recently been raised by that clever, if somewhat misguided philosopher, Count Tolstoi. He equivocates naught, but sets down in his usual trenchant, unhesitating, and unceremonious style the doctrine of celibacy. If anything is written down in the records of past human experience as a failure it is celibacy. Suppose the doctrine should reach the modern heart, and create a new passion for itself, and a new contempt for the claims of future beings, who would most be affected? The intelligent reading classes are those whom Tolstoi reaches, and they would cease to father the future; while the brute-force and ignorant herd would continue to multiply, and occupy the earth. Down topples your civilisation, and your institutions born of intelligence, until the very rot and riot of licentiousness would cure itself by a slow revolt against extremes, or would end in the degeneracy of savagery. But celibacy never has been purity. It never will mean purity. While there is no question of the physical continence of many men under the pressure of strong moral obligation, it is equally true that the history of celibacy from most ancient times to ours has been a useless struggle against the noblest function of life. That is the power to give life. Nor can any possible abuse of power ever excuse us for refusing the endowment of our being. It is not the grandest thing to live, and swell out our self-existence with multiplied negatives of vice, or even with positive virtues; the truly noblest thing is to multiply noble lives, and endow them with the benedictions of our own manhood.

Eternal Tolstoi, though he were tenfold as wise, and a hundredfold sweeter than he is, would not be worth as much as a hundred Tolstois, each one wiser than the father; or a hundred generations of Tolstois, improving to the last. The logic that is good now always was good; and there was a time when, if celibacy had been applied to the English stock, the world would sadly have been the loser. It would have forestalled and prevented Shakspeare, Bacon, Milton, Scott, and we know not who else of those who humanise us. We could not forgive Erasmus Darwin had he taken vows of celibacy, and robbed us of his grandson Charles and the revelation and inspiration of "evolution." It is not easy to say what the world really has lost through the celebates that it has borne. The highest duty of high-souled men is to beget the future. It is not a question, as our Cossack would have us think, of annihilating the race; it is a question of annihilating progress and giving over the future to the grosser sort of parentage.

We turn to observe the contemptible conception of life itself involved in celibacy. No one can have any vision of what life is, as expounded by evolution, without a feeling of worship. And that he the worshipper does now exist as the result of half a million million of years of life progress on our globe, astounds him with the awe and dignity of the inheritance. All life evolution in the past has depended on death and birth. It seems inconceivably contemptible that now we should hold it to be our duty to stay the progress.

We can have no contention with Tolstoi as to the baseness of that dissoluteness, characteristic of a large share of the young men of Russia, and to perhaps a less degree the young men of other countries. No one proposes any longer to excuse habits that ruin both intellectual and physical intent. Debauchery and degeneracy are one and the same, and must be eliminated from society. When Tolstoi makes for us a creed including proper abstinence from alcoholic drinks, from excess in eating, and engagement in some form of honest labour, we are not far from agreement.

But he does not rest here. He passes promptly, and this is his latest propogando to the assertion that love is, as a rule, an evil and false motive. He refers, of course, to love between the sexes, and to friendship of an ardent sort as well. He is always thorough in what he does, and is not content with simply denouncing marriage, but love itself. It is folly to allow that love is a true power, and then deny the propriety of marriage. What he would do with the needfulness of liking and disliking, or with that deeper physical law of atttraction and repulsion that we can not avoid or destroy, we do not know. Perhaps he would advise us to give up love of human beings for a passion for flowers, as the Coreans do. He is of opinion that conjugal infidelity is on the increase, owing to the idealisation of the subject in current literature. But when he attacks the habit and theory of falling in love, and the false philosophy of love that it rests on, we are heartily with him, and all this discussion will at least do this, that it will finally compel rational people to comprehend that the affections, or, in general, the emotions, should be as thoughtfully under control of the reason as should our intellectual processes or our actions.

But is the cure of an irrational habit to be found only in not loving at all? Have we all been such fools?—and is Tolstoi the only sane man? He has already offered himself as inspired moralist: is he also inspired poet?—and is his inspiration to obliterate poetry? "The truth is," says he, "that love has been quite overrated; and it is not a fit object to consume our best energies. Marriage is not a progress, but a fall. Love, however, we may try in prose or verse to prove the contrary, never can facilitate the attainment of an aim worthy of men." Here are two points that we bluntly protest against allowing. By this decree he proposes at a stroke to banish love as a power in the world, and to unsex us. It is a great and a terrible task. Terrible because, in so far as he secures followers, he is sure to open before them not a higher life of evolution, but a fanatical struggle to overcome and kill out the purest and grandest functions of our being. Instead of exalting, he aims to destroy.

But why not? The world, says Tolstoi, is going to end some day as a habitable place. To be sure, its glory is that it is now clothed with life, and that we can fill it with moral life. But have we not had enough of it? Let us wind up affairs and put an end to development. He writes: "We only find ourselves face to face with the familiar teaching that the world will have an end, and that of science which teaches that the sun is losing its heat, and the result will be the extinction of life on the earth. But the churches set up marriage as an institution and a sacrament, and have lost the ideal, which is the union of all living creatures by common bonds." To be sure, this is the wind up of the progression of life, the end of higher aspirations; but it is the fulfilment of an ideal for those who already live. This is the run of the logic of this great prophet, the Bear of the North. We see in it only impertinence and coarseness. It is that sort of revolt against nature which would be conceived nowhere but in Russia.

Whatever some may think of an effort to rehabilitate the first century on the threshold of the twentieth, all will agree that the probabilities are against the veritableness of an interpretation that carries us back to the cave life of the earlier centuries, and the asceticism and fanaticism of the middle ages.

Let us not be misunderstood. The vile corruptions of love, the shallow interpretations thereof, the selfishness often mistaken for it, the hideousness that hides under its cover—all these must be eliminated. Tolstoi, having gone through the round of the false and pretentious, sees his mishaps, regrets his failures; but, extremist that he is, he sees no remedy but in clipping the heartstrings.

DIAMONDS IN METEORITES.

An interesting paper on diamond-bearing meteorites was read at the Washington meeting of the American Association for the advancement of Science, by Professor A. E. Foote, of Philadelphia. The author describes the meteoric iron found near Canon Diablo, Arizona, fragments of which contained diamonds. Crater Mountain, 185 miles north of Tucson, is a peculiar circular elevation, strikingly like the crater of an extinct volcano. It rises 432 feet above the surrounding plain, and its cavity is $\frac{3}{4}$ mile in diameter. Its interior walls are so steep that animals once entrapped within them never escape, but leave their bleached bones at the bottom. The rim of sandstones and limestones is uniformly uplifted on all sides at an angle of 40°, while the bottom lies at a depth of from 50 feet to 100 feet below the general level of the plain.

Although the cavity is crateriform, no lava, obsidian, or other volcanic product was found. Small meteoric fragments were scattered over an area about a third of a mile in length and 120 feet wide, extending north-west and south-east. Exactly parallel with it, but about two miles from the base of the crater, were found two large masses, one weighing 154 lbs. and the other 201 lbs. Both were deeply pitted, and the larger one was perforated in three places. The latter is now the property of the *Ecole des Mines*, Paris. Smaller masses were also found, numbering 131 in all, ranging in weight from $\frac{1}{16}$ oz. to 6 lbs. 10 oz. Several of them were coated with aragonite. About 200 lbs. of angular sulphureted fragments, also of meteoric origin, were found near the base of the crater, a few of which showed a greenish stain resulting from oxidised nickel.

A fragment of a mass weighing 40 lbs. was examined by Professor G. A. Köring, who found it to be extremely hard, a day and a half being taken in making a section, and several chisels were broken in the operation. An emery wheel was ruined in trying to polish it. This led to closer inspection of certain exposed cavities, when small black diamonds were found which cut polished corundum as easily as a knife separates gypsum. These diamonds are mineralogically of great interest, their presence in meteorites having been unknown until the year 1887, when two Russian mineralogists found traces of diamonds in a meteorite mixture of olivine and bronzite. By treating the amorphous carbon in the cavities with acid, a small white diamond, $\frac{1}{50}$ in. in diameter, was found, as well as troilite and daubreelite. The general mass contained 3 per cent. of nickel. The Widmanstattian figures were not regular. The indications are that a large meteorite, weighing about 600 lbs., had become oxidised in passing through the air, and had burst before reaching the earth. It is scarcely credible that the crater could be accounted for by meteoric impact, and its origin is a problem unsolved. The fact of special interest may be accepted as proved that diamonds have been found in meteoric fragments. The specimens were carefully examined by the geologists present at the reading of Professor Foote's paper, and while there were many opinions expressed as to the so-called crater, and as to its relation to the meteor, none doubted the genuineness of the diamonds.

HELPFUL HINTS:

Being Answers to Correspondents.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

T. BISHOP.—There can be no doubt that it is a mistake to interpret the story of Noah's Ark too literally. We would certainly recommend you to believe the deductions drawn from modern science, provided you understand the methods by which they have been arrived at. To give any other answer to your question would involve a contradiction in terms.

JAMES HOPE WALLACE.—Your suggestions as to "noise ripples" are very well expressed, but we regret that they are unsuitable for our columns.

JAMES SCOTT.—The moon gives rise to tidal effects in the atmosphere, and so exerts an influence upon the winds and weather. This influence fades into insignificance, however, in comparison with that of the earth's rotation, and of the sun's heat. For practical purposes it is certainly to be neglected.

J. P. MUNRO.—Your letter is very interesting. You do not state, however, whether your bread and other food is specially cooked without the addition of salt, nor do you inform us whether your diet is exclusively vegetarian.

E. FAIR.—The price of the *Nautical Almanac* is only half-a-crown, and it is the only reliable authority on astronomical data in the English language. We cannot afford space for a list of the contents, but if you state precisely what information you desire, we will inform you whether it is to be obtained and where.

CENTURION.—You are right as to the "scorpion girt with fire." If, under these circumstances, the reptile stung itself to death, we would assent to a verdict of suicide. It is, however, extremely doubtful whether such an act has ever been observed. As to the statement that rats destroy themselves, it probably arises from the fact that great hordes of lemmings, in search of food, periodically traverse Swedish Lapland, swimming lakes and rivers, devastating the country, and stopped by no obstacle, natural or artificial, until, eventually, they lose their lives in the Gulf of Bothnia. In this case it is an instinct of self-preservation, not of self-destruction, that prompts the fatal plunge. Instinctive self-destruction would be contrary to the laws of nature. On the other hand, suicidal acts may be committed by dogs, and other animals, when in a state of madness. But we believe that deliberate suicide is the outcome of reasoning of a higher order than can be exercised by any of the brute creation, and in any case by which this statement might seem to be impugned, we would incline, most strongly, to call in question the state of mind of the deceased. We think that, in such a case, a careful inquest should be held. Perhaps the phonographic methods that have been recently elaborated by Professor Garner might be used to interpret the evidence of relatives and friends!

E. A. KENNEDY.—We are obliged to you for the information sent, a part of which is published on p. 6. We keep in view the suggestion to publish information of the movements of comets, etc., in SCIENCE SIFTINGS. Space is limited, however, and it is necessary that we should select for publication what is likely to be of most interest to the majority of our readers. We freely acknowledge that your prognostications of the weather have been fulfilled in a most remarkable manner, and we regret that such interesting matter should have been necessarily crowded out. Even as it is, however, we are glad to be assured that students of astronomy and meteorology cannot afford to be without SCIENCE SIFTINGS.

HERBERT SUMMONS.—We have received a large number of queries for the "Science Queries and Answers" column. Whether all, or even the greater part of these will be used, depends upon how long the prize competition in question is retained as a feature of SCIENCE SIFTINGS. Queries are paid for at the date of publication.

GEO. SUTCLIFFE.—Plants are injured by the sulphurous products of the combustion of coal gas, and there is no form of burner by the use of which these products of combustion can be eliminated. You may remedy the evil by conveying the burnt gases to the open air through a ventilating tube, or by treating the coal gas with a desulphurising solution.

MICRO.—The small micro-plates for minute images, used for charms, etc., are all made by the wet collodion process, which, of course, shows little, if any, granularity in amplification. With careful exposure and development the same results may be obtained on many of the dry plates of the "slow" kind. The Fry Manufacturing Company, of 5, Chandos-street, Strand, make special micro-plates, coated on patent plate-glass, which may probably suit your purpose.

*** We have been compelled to hold over many replies to correspondents until next week.

SALE AND EXCHANGE COLUMN.

Tariff: First 20 words or less, 6d. Every additional 3 words, 1d. If replies are to be addressed to the office of "Science Siftings," a charge of 3d. will be made for booking and forwarding replies.

Deposit System: To facilitate the transaction of sales between strangers, the purchased money may be deposited with us. We will acknowledge the receipt of the deposit of both parties, and hold the money until we are satisfied that the goods have been returned or the purchase satisfactorily concluded. When remitting to the Seller, or returning the deposit (if no sale be effected, the following amounts, to cover expenses) will be deducted:—For amounts under 40s., 6d.; for amounts over 40s., 1s. In the event of articles sent on approval not being returned, or notice being given to us within 4 days, the sale will be considered effected, and the purchase-money forwarded to the Vendor.

Exchange: We cannot undertake to receive or forward articles; money, therefore, to the estimated value of the exchanges should be deposited with us.

Remittances, etc.: All remittances must be made either by postal order or halfpenny stamps. Envelopes must be marked "Sale and Exchange," and addressed to the Manager, "Science Siftings," 73, Fleet Street, London, E.C.

The optical lantern in the class-room. Slides made to order from prints, drawings, etc., 9s. per dozen. Send print and 12 stamps for sample. Bellyse, Steeple Claydon, Winslow. 1

Electric light. Small incandescent lamp; low voltage; a novelty for amateurs. Post free 7d. stamps. P. Rowsell, 1, Walcot-square, London, S.E. 3

Collection of scientific instruments. Telescopes, microscopes transit, barometers, observatory, telephones, Wimshurst machine, microscopic slides, cameras, micrometer, photometer. List 3 stamps. Hutchinson, Observatory, Liversedge. 2

Minerals. Large collection to be cleared from 2s. doz., named, free. Nicholls, Photographer, Redruth, Cornwall. 1

Non-toning paper. Process rapid. Easy, cheap. Photo., Nonsuch packet, instructions, 7½d. S. Briggs, 32, Cobden-street, Stockton-on-Tees.

Telescope by Spencer, Browning, and Rust, 15s.; 2 lenses, 6 and 4 inches diameter, 4s. Reuben Walton, Fan Fold, Armley, Leeds.

Fossils. 20 named varieties, 3s. free; 12 ammonites, 3s.; 20 varieties minerals, 3s.; 12 ores, 3s. Chas. Wardingley, Littleboro, Manchester.

Fine healthy pupæ. Fagi, Elpenor-Porcellus, Tiliæ, etc. Send stamp for price list. Jefferys, naturalist, Tenby.

Electric bell, battery, etc., complete, 7s., cheap. Lane, 32, Goldsmith-road, Leyton.

"Observations on Aneurism"; "Dapaytrin on Diseases of Bones"; "Hewson on Lymphatic System"; 2 vols "Physiological and Pathological Chemistry"; Sydenham Society Works, 2s. each. No use to owner; purchased among miscellaneous books by mistake. Offers. G. Larner, Darenth, Dartford.

Electrical cabinet, fitted with 6 new dry batteries, has 8 day alarm clock, with electric lamp underneath, electric bell with wire and push, detachable oil can, lit by platinum wire, etc. Bargain 33s. W. L., 136, Brecknock-road, N.

Electric Motor, Siemen's pattern, ⅞-in. armature, armature wants rewinding, otherwise perfect, 12s. 6d. Platten, North, Lowestoft.

Wanted, an electric bell, working order. Exchange; cash if cheap. G. Jaques, Wath, near Rotherham.

Wanted, a powerful horse shoe magnet. E. Goodyear, Radnor Park, Dalmuir, Glasgow.

Wanted, apparatus for producing prismatic fountain. Price to Bury George, Algecirus, Spain.

Pair of binocular glasses, in case (jointed), by Murray and Heath. Bargain 65s.; cost 9 guineas. Williams, 2, Gloster-terrace, Kew.

Field and marine glasses, very powerful, 12 lens, by Archbutt. Cost 12os.; exchange small portable harmonium or anything useful. What offers? C. Parsons, 32, Orchard-place, Clarence-road, Clapton, N.E.

Old wheel barometer, perfect order, 15s.; rather plainer one, 10s. E. Davis, 60, Essex-road, Islington, N.

Pedometer, registering to 120 miles, nickel plated. Cost 14s.; price 6s. 6d. C. Rosslyn, Wallington, Surrey.

Wanted, surveyor's theodolite, level, staff, etc., Elliot's preferred. Rattenbury, Exchange, Bradford.

Wanted student's (or portable) miscroscope, must be by good maker. A. H., 84, Dresden-road, Upper Holloway.

Glass case, 3ft long, 2ft. 6in. high, 1ft. wide, containing stuffed badger, weasel, stoat, and 4 young rabbits, beautifully set on artificial rock, perfect condition. Price £4. Sketch and full particulars, E. W. Jackson, Carisbrooke, Malvern.

Eighty eggs, 45 sorts, hawks, snipes, others, rare, 6s. No cards. L. Frost, Bampton, Devon.

Two fine teeth of mammoth, from Cromer Forest bed series, suitable for museum, 25s. Andrews, 1, Tavistock-terrace, N.

Will any gentleman exchange eggs, names wanted, for coming season? can supply many good sorts. P. Bunyard, The Nurseries, Ashford, Kent.

Stuffed birds, rare authenticated British specimens, stilt, honey buzzard, marsh harrier, bearded and crested tits, etc., well set up. What offers? Dr. Green, Ripon.

Wanted by collector, eggs in sets of the rarer British birds. Francis Edward Stemson, 6, Brunel-terrace, Newcastle-upon-Tyne.

Wanted, a stuffed godwit or redshank, for case of birds. Sheppard, 63, Carr-lane, Hull.

Lancaster's 1892 ½ plate instantograph camera, slide, tripod, and R.R. lens. Only 67s. 6d. 14, George-street, Stroud, Glos.

Will give a splendid ½ plate photographic outfit in exchange for anything useful, furniture preferred. W. Cowen, Hextol-terrace, Hexham.

Wanted, ½ plate camera, slide, and stand. no lens, must be cheap. Young, jun., Somersham, Hunts.

Wanted, a No. 3 Kodak regular. State lowest price for cash. Lucas, Claremont College, Blackpool.

Wanted, ½ plate camera, complete. Approval. Lancaster's preferred. A. Lewthwaite, 48, George-street, Devonport.

Wanted, quantity of gutta-percha insulated wire, No. 18. Gregory, Jersey.

Automatic electric machine (1d. drop), for tea gardens or public place, £4. T. Thomas, 3, Newman's-row, Lincoln's-inn-fields.

Telephone, line complete, 28 posts and insulators, 1½ mile wire, good instruments, bells, batteries, £10. Knight, Barfield, Farnham.

Sale, 5 candle-power dynamo, wheels, etc. Cash. Tbos. Hannay, jun., Rokeby, Bridge of Allan.

Beetles. Wanted, exotic beetles. Apply by letter to Dr. A. Heath, 114, Ebury-street, S.W.

Powerful field glasses wanted, in exchange for Boston lever silver watch, value 20s. Moore, 64, Oswald-street, Blackburn.

Wanted, good pair of field glasses, moderate price. Foster, 6, Seaview-terrace, Lipson, Plymouth.

Good old-fashioned theodolite; will exchange for good mail cart, or 30s. cash. Clark, 152, Borough-road East, Middlesboro'-on-Tees.

Wanted, a Nicholson's 42 in. electrum and ebony centrolinead, complete. Rhodes, 7, Mitre-court-chambers, Temple, E.C.

Wanted, second hand, a well made mahogany cabinet, to hold microscopic slides, no objection to take some slides. H. W. Melleships, 111, Westbourne-grove, London. W.

Student's microscope, Gould's improved, 4 powers, all accessories, mahogany, velvet lined case, 65s. Deposit: would exchange musical box. H. Allsop, Station House, Wirksworth, Derbyshire.

Alligator, stuffed, fine specimen, length 56 in., 15s., approval; exchange strong cage, pet lamb, goat, or fowls. Wakefield, Town Pier, Gravesend.

Wanted, stuffed, great skua, little bittern, grey plover. Hesley Hall, Tickhill, Rotherham.

Wanted, telescope stand, take 1⅝ in. tube. Hamblycot, Lewin-road, Streatham, London.

Wanted, good telescope, mounted on tripod stand, brass or otherwise. State size, strength, price, etc., to R., Bruce's Hotel, Carnoustie, N.B.

Splendid range and field telescope, 15⅝ in. draw out, with cloth case, scarcely used, 8s. 6d. B., Firsleigh, Isleworth.

Wanted, good hand camera. Would exchange quadrant tricycle, valuable water colours, etc. Mitchell, Hillside, Tavistock.

Wanted to purchase, 2 or 3 dark slides for Lancaster's ½ plate instantograph, 1892. Hawkins, 71, Finsbury Park-road, N.

Wanted, ½ plate instantaneous lens and shutter: exchange preferred. 78, Clifton-street, Brook's Bar, Manchester.

Wanted, whole plate camera, by good maker, without tripod or lens, must be in perfect condition and working order. State price. Wethington, Woolley Park, Wakefield.

THE
GUTENBERG PRESS.

Printing
AND
Publishing.

ADDRESS:
Manager, Printing Dept.,
78, Fleet Street, London, E.C.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.
PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. DALLMEYER "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, 25, NEWMAN STREET, LONDON, W.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*; 3 *months,* 1*s.* 9*d.*

Advertisement Offices: 168, Fleet Street, E.C.
"Sale and Exchange" Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

LONDON: SATURDAY, APRIL 30, 1892.

SCIENCE NEWS AND NOTES.

"Ignorance more frequently begets confidence than does knowledge; it is those who know little, and not those who know much, who so positively assert that this or that problem will never be solved by science."
—DARWIN.

Disease

in general needs no further explanation than the existence of life. It is as natural, said Dr. Pye-Smith, lecturing before the Royal College of Physicians this month, and as physiological as health. No living thing is immortal, and life is a constant struggle against surrounding forces, in which each individual organism succumbs after a while, by handing on its life to its successor when it has insured the victory of the race. Pathology is only a chapter of physiology, which for convenience we have separated from the rest. We call disease that which brings us discomfort, and then look upon every disease as abnormal, obtrusive, unkindly; but, if we knew it, the highest temperature of fever is as strictly in accordance with the laws of animal thermogenesis and thermolysis as the slight diurnal oscillations of health; and the excessive secretion of the kidneys in diabetes is as much a part of the system of nature as the moderate increase produced by a cold east wind in a healthy man. The processes of degeneration and decay which lead to death should be regarded as correlative with those of growth and development which follow birth. It is as natural for the old man to shrink in bulk and droop in stature, for his permanent cartilages to ossify, his hearing to grow dull and his memory weak, as for the child to grow, for his bones to set, and his mind to develop.

It has Long been Known

that human beings are liable to be the hosts of parasitic beings less highly organised, but living, growing, and reproducing like ourselves; and in recent times we have learnt that, in addition to the diseases produced by the presence of animal parasites, another large group is due to the invasion of countless hordes of minute parasitic plants, but to regard filariæ and bacilli as merely "causes of disease" in man is to take too narrow, too human a view. Every kind of beast, and bird, and fish, and many of the lower classes, are known habitually to harbour parasites. In the majority of cases this is without injury to the host; indeed, if the parasites were invariably destructive the victory of the individual would prove destructive to the race, since, although a host can live without a parasite, the parasite cannot live without his host. The fact is that if we call "disease" whatever is abnormal, then the "pathological" condition is to be free from parasites. The bare and inhospitable state in which the most civilised of mankind keep their bodies is only maintained by ceaseless care and vigilance; as soon as these are intermitted, numberless evicted tenants resume their natural right of domicile. The immense majority of our fellow-men, in the past and in the present, have been and are the contented hosts of a dependent fauna, which finds as natural and unblamed a habitat on or in the human body as birds in the air or fishes in the sea. From the point of view of the tænia, the trichina, or the pediculus, man is in general part of its environment, and in particular its homestead and its barn, while sanitary, economical, and pathological questions, from the parasitic point of view, refer, not to the host, but to the guest. Dr. Pye-Smith suggests, then, that we look upon diseases not as unnatural, lawless, heterogeneous, abnormal, revolutionary, but as parts of the vast order of creation.

Vegetarians and Animal-feeders

seem to have found much to say about a recent paragraph that appeared in SCIENCE SIFTINGS, dealing with the amount of work that has been done under certain conditions with vegetable diet only. The great Roman general, Corbulo, we are informed by Tacitus, was in his Armenian campaign reduced to extremities, his army having suffered, not indeed from losses in battle, but from being driven to satisfy its hunger from the flesh of sheep. To the average Briton into whose dietetic cult the mutton-chop enters so largely, this announcement must seem inexplicable; so much so that he might be excused for thinking lightly of the stamina or pluck of his forefathers who allowed themselves to be conquered by soldiery for whose stomachs the flesh of sheep was too strong. This fact is, however, as Tacitus has stated it; and we know from other authorities that animal food as a constant element in the Roman soldiers' fare was found hurtful to his health and efficiency. Cæsar, in his Gallic war, tells how for several days his troops did without corn-meal, and sustained the extreme of hunger on mutton. Corn-meal was the grand necessary of life to those legionaries who, led by Cæsar, subdued the world, and who counted themselves starved, and were apt to mutiny if reduced to the "famine fare" of animal food.

Habit is Second Nature,

and it was no doubt due to this cause that these old world soldiers found mutton a privation. The *Lancet*, without for a moment lending countenance to the vegetarian who would cut off butcher's meat from human consumption, concedes to him that an animal diet, unbalanced by a due proportion of the "kindly fruits of the earth," is distinctly prejudicial to the consumer, particularly to the resident in cities, whose opportunities of open-air exercise are few and far between. We are still in want of such a series of experiments on the nutrient and sustaining values of foods, vegetable and animal, as the late Professor Parkes, of Netley, instituted with such conclusive results on the various

kinds of drink, from water up to spirits. Till statistics of equal comprehensiveness and accuracy are furnished us we must be content to remain imperfectly informed as to the competing claims of the two great factors of solid alimentation. In the half light we possess on the subject we must expect partisanship on either side—the vegetarian insisting on the exclusive virtues of his special diet, and his carnivorous antagonist appealing to physiology and personal experience in favour of butcher's meat. "Competitive dietaries" are thus forced on a bewildered public, and the physician is often called in to repair the damage done to themselves by those who, on either side, have had too much "the courage of their convictions." That men and women should be trained to become "the intelligent custodians of their own health," as Sir James Coxe so well expresses it, must always remain a pious opinion till science and experience have authoritatively pronounced themselves on the due balance—not antagonism—between the animal and vegetable factors of daily food.

The Reform of Athletics

is again engaging the attention of Professor Angelo Mosso, of Turin. The eminent physiologist is a well-known authority on the training of the body, and he has always attacked the gymnastic system of Italian schools. His great argument is the distinction between robustness and strength. The former, he maintains, is often developed out of proportion to the bodily health, as, in order to insure an abnormal power of muscle, the other organs are *pro tanto*, impoverished. As a consequence, modern gymnastics (and not in Italy alone) are open, in physiological eyes, to grave objection. Repeated exercise, he admits, augments muscular force—the muscular tissue itself becoming thickened and the organism habituating itself to the products ("poisonous" as these are) of muscular waste. But, as is well known, during intense strain or extraordinary effort the blood no longer circulates healthily, the respiration is altered, the pulsations of the heart are irregular. The artificially widened thorax, on which the athletic enthusiast so prides himself, is, according to Professor Mosso, of a highly relative value, for even without such widening we always respire a sufficient quantity of air, and even habitually, as he further maintains, "we respire more air than is necessary." The gymnastics of the schools have this defect that they "localise fatigue in some groups of muscles," whereas really healthy exercises should induce a fatigue of the whole body—a symmetrical fatigue—and that gradually. Recent experiments on the results of fatigue of the muscle have shown that that tissue suffers more from a maximum than from an ordinary contraction; and, besides, that to the weary muscle a given effort is more hurtful than to the muscle which has rested.

Death in the Tea Pot

has again come to the fore, because a young urchin has died for drinking hot tea without milk. The *British Medical Journal* in commenting on this incident, mentions that the tea had been left in the oven for some time, so that it had become a strong decoction of tannin. In being drunk without milk, the tannin was not brought into a relatively harmless albuminous tannate. It is on account of this method of making tea that it is so injurious to digestion. Neither the Chinese nor the Japanese, who know how to make tea, use milk with it; but with them the hot water is poured on and off the leaves at table, and is drunk as soon as it becomes a pale straw colour. No people in the world drink so much tea as the Japanese, yet in Japan it is never injurious to the digestion, as by their method of preparation the tannin is not extracted from the leaves.

A New Use for Oil at Sea

has been discovered. It is intended to apply oleaginous matter to the reduction of friction on the sides of a ship, caused by the passage of the ship through the water, and thereby increasing her speed. The idea embraces many features that would seem feasible, but whether or not it would practically make any difference remains to be seen. The oil is fed in minute streams against the sides of the vessel by means of a series of perforated pipes, adjusted to the bow and extending from the keel to the water line, or higher. The progression of the craft passes the oil back toward the stern, and at the same time the inward pressure of the water prevents the oil leaving the sides of the vessel without doing its duty. Perhaps the oil might be more thoroughly distributed were the ship built with grooves along the sides. Another suggestion is to submit the oil to a chemical treatment, whereby it would prevent weeds and barnacles adhering to the vessel's bottom, and thus increasing the scope of the oil's duties.

Ten Species of Micro-Organisms

may be found in any sample of water, if we are to credit a recent analysis of 400 springs, wells, and streams, and when these are not species ordinarily met with, the water should not be used for drinking. This new rule may be considered as a fair guide. The experimentalist found more than ten species in only 59 waters, but 169 waters contained more than 1,000 organisms per cubic centimetre, 66 having over 10,000 and 40 over 50,000. He found in all 28 species, and proved that the number of colonies does not correspond with the number of species. Putrefactive bacteria, which liquefy gelatine and give independent evidence of impurity, are almost invariably absent from spring water, but occur where the number of species is great, and where the number of colonies does not exceed 10,000 per cubic centimetre.

Maxim has been Outdone

by the invention of a new quick-firing Winchester gun, which, in the rapidity of its death-dealing capacity, is said to be ahead of any other yet designed. It was recently tested at New Haven, Conn. (U.S.A.). The number of shots ejected per minute was 900. The Maxim machine gun holds the record up to 750 shots per minute. The new Winchester has a water-jacket surrounding the barrel, that holds one gallon of water, which is evaporated in one minute when the gun is in operation. In experiments made without the water-jacket, the barrel became too hot for safety in less than half a minute. The exploded shells, as they are thrown from the breech, rise about two feet over the gun, and fall in what appears to be a gracefully-curved bar of burnished brass. The gun is the invention of Messrs. Browning Brothers, gun makers, of Ogden, Utah.

A Scientific Phenomenon

is claiming the attention of certain scientists just now. Briefly, a beam of sunlight is made to pass through a prism, so as to produce what is called the solar spectrum, or rainbow. On placing the ear to a vessel containing silk, wool, or other similar material, upon which the coloured lights are made to fall, distinct sounds are heard. Thus, if the vessel contain red worsted, and the green light flashes upon it, loud sounds will be given, but only feeble sounds when the red

and blue parts of the rainbow fall upon the vessel, and other colours make no sound at all; in a word, every kind of material gives more or less sound in different colours, and utters no sound in others.

Wash all Food

whenever practicable before eating would appear to be an indispensable maxim for the avoidance of disease. This applies particularly to fruits. The following curious instance is reported in a French journal by M. Schnirer of the ease with which tubercle bacilli may be disseminated. While at work one day in the laboratory of Weichselbaum, he sent for some grapes to refresh himself with. The fruit had been kept up for some time in a basket outside the laboratory, and was covered thickly with dust, so that the water in which it was washed was absolutely black. On examining the water, he reflected that, inasmuch as the neighbouring street was traversed frequently by consumptive patients going to the clinic, the dust probably contained the dessicated sputa of these patients, charged with tubercle bacilli. To settle this point, M. Schnirer injected into three guinea pigs 10 cub. centim. of the water in which the grapes had been washed. One animal died in two days from peritonitis, the two others died on the forty-eighth and fifty-eighth days respectively, presenting marked tuberculous lesions, especially at the place of injection. The water in which the grapes had been washed was taken directly from the faucet, and the glass containing it had been sterilised. Neither the boy who had brought the grapes nor the merchant who had sold them was tuberculous. Hence the cause of infection was beyond doubt the dust on the grapes. This experiment is another illustration of the danger arising from the dissemination of dessicated tuberculous sputa in the air.

The Science of Mathematics

has a long reach. Its capabilities are no more strained by the task of determining the distance of a star or predicting the exact moment of an eclipse than by that of finding the contents of a corn-crib or the sum total of a grocer's bill. Strictly speaking, the one is no more wonderful than the other, save that the higher process calls for special knowledge which comparative few persons acquire. But to the average uninstructed sense there is a near approach to the supernatural in some of the exploits of astronomical experts. Of this sort was the ciphering out, so to speak, of the planet Neptune, sixty times as large as the earth and twenty-five hundred million miles away from it, by Prof. Adams, the lately deceased British Astronomer. He observed certain perturbations of the planet Uranus, and deduced therefrom that there ought to be just such a planet as Neptune discernible by a good telescope at a certain point in the heavens. Dr. Galle of Berlin turned his telescope to that precise spot, and there was the new planet—new, though innumerable ages old.

The Flint and Steel Theory

is advanced by Sir Robert Ball as the most simple and probable explanation of the mysterious phenomenon, the expiring gleams of which are known as "the new star in Auriga." It must never be forgotten that the stars, properly so called, are merely the luminant points of the universe. The visible points of a town at night consist only of the lamps, or lights of one kind or another; they are very unimportant in comparison with all the multitude of non-luminant objects that the town contains. And yet when we view the town from a distance at night it is only the luminants that we see, the buildings are invisible; it is only a lamp here or a candle in a window there that can be discerned. In like manner the stars that we see are only the luminant points of the universe, and the non-luminant bodies are probably millions of times more numerous. It is an extremely unlikely occurence that any two of these dark bodies should collide, but they abound in such untold millions that, though it may be highly improbable that any particular pair should collide, it is probable enough that some pair may do so.

When two such Bodies do Collide

there is an evolution on a vast scale of what we see on a small scale when flint and steel are struck together. The brilliance of the new star while it lasted may not have fallen far short of the brilliance of the sun, but even this grade of splendour, Sir Robert Ball considers, could have been produced by a collision between two bodies—say, each as large as the moon—if they moved with speeds as great as those of some of the stars that we know. If anyone doubts this, let him consider the following fact, which can be verified by anyone accustomed to such calculations. Let a stone not larger than a child could carry collide with another stone of the same size moving in the opposite direction, let the speeds with which the bodies are moving be as great as those of certain stars, then the collision would have as much light-producing capacity as would a series of engines amounting to 100,000 horse-power, driving dynamos for one minute devoted to the production of electric light.

Why are Pigs not Skinned

by our farmers before sending them to market, or by our butchers before exposing them for sale? It seems somewhat remarkable that while the calf, the sheep, and the ox are sold to us ready skinned, the pig should be sold to us in the proud possession of his hide, which we consume to the prejudice of our digestions.

The Value of a Pig's Hide

is estimated at from five shillings to seven and six pence, and this is the price paid for them by the skin dealers, who import the hides chiefly from Russia. The variety of purposes to which pig-skin can be applied, is, we need hardly mention, almost as great as those of our other domestic animals, and it seems to us that the question is one of the greatest importance to our farmers and graziers, to whom a few shillings extra on every pig killed would mean a considerable item. The public would, we believe, soon become accustomed to buying its pork skinned, and butchers and farmers might well co-operate in this matter to their mutual advantage.

Recent Examination of the Spectrum of Mars,

writes Mr. Fred. W. Booth, by Dr. Huggins (the Herschel of the spectroscope), sustains the opinion long ago expressed by Sir John Herschel, that the colouring really belongs to the substance of which the planet is composed, and thus corresponds to the tint of many of the clays, marls, and other soils, which form so largely the superficies of the earth. Mr. Booth considers this more accurate than the reply we published to Query 68.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

GLEANINGS OF THE GLOBE.

NATURALISTS say that a single swallow will devour 6,000 flies in a day.

THE mean annual temperature of the globe is 50 deg. Fahrenheit.

CUVIER maintained that instinct and intelligence stand in inverse ratio to each other.

DARWIN quotes an old writer who says: "A dog is the only thing on earth that luvs you more than he luvs himself."

THE specific heat of a mutton chop is given by a contemporary, as 0·5 calorie, which is equal to about 1·5 foot pounds.

THE "canals" that intersect the Martian Continents were first detected by Schiaparelli, but their real existence has not been abundantly confirmed.

IT is now universally admitted that the rings of Saturn are not continuous sheets, either solid or liquid, but mere swarms of separate particles, like swarms of meteorites.

THE rapid changes which the markings of Jupiter undergo, show that this giant planet is still in a semi-molten condition; and it may be, to some extent, self-luminous.

THE swarm of little rocks which revolve around the sun between the paths of Mars and Jupiter probably represent a planet spoiled in the making. The view is also held that they are fragments of an exploded planet.

IT takes two to produce a disease—the blow and the reaction, the irritant and the patient. When a man complains that wholesome food disagrees with his stomach we might retort, says Dr Pye-Smith, that his stomach disagrees with his food.

AN inventor has constructed a novel device to do away with the enormous pressure of water against the bows of ocean steamers. It consists of one or more screws on each side of the bow, which throw the water aside and create a dry well in front of the vessel.

ACCORDING to Dr. H. A. Kelly, permanganate of potassium and oxalic acid are harmless to the hands and are germicidal. Soap and water plus the permanganate of potassium and oxalic are, he says, the only true germicides, and the best disinfectants we possess to-day.

IF three puppies of the same litter are fed, from birth, respectively, on beef-tea, plain water, and the meat from which the beef-tea has been made, the first puppy will die in about three weeks, the second in about six weeks, and the third will be a strong, healthy, dog in six months.

AN electric light and power company of St. Louis has brought a suit for theft of electricity by bridging wires entering a store before the wires entered the meter. The defendant raised the point that electricity cannot be stolen, inasmuch as in order to constitute stealing there must be an *asportation*, a condition impossible in the case of electricity, which, not being in any wise under control, is, therefore, not the goods, property, or effects of anyone.

BY the subjection of common air to a pressure of 1,125 lbs. to the square inch, or 75 atmospheres, with a condenser kept at 135° C., the air is reduced to liquid form; and the liquid, when allowed to evaporate, produces a temperature of 200° C. This is within 73° of absolute zero, which is 273° C.

COMETS are only visitors, as it were, to our solar system. They are drawn into it from outer space by the attraction of the major planets and the sun. The tail of a bright comet is by far the most imposing feature. Its length is seldom less than 5,000,000 to 10,000,000 miles, and frequently attains 50,000,000 miles. But although the bulk of comets is so enormous, their mass or weight is extremely small, being in no case more than one one-hundred-thousandth the weight of the earth. It is now known that four comets move in the same paths around the sun as four particular swarms of meteorites. From this it appears that there is a real and close connection between these comets and the swarms of meteors.

EVEN a balance which is not perfectly accurate may be made to give the true weight of a body, or at least sufficiently near the true weight for all practical purposes. To do so place the substance to be weighed in one scale, and pour sand or any other fine-grained material into the other until the exact equilibrium or balancing is produced; then lift off the body, and replace it by known weights until the proper balancing is again established. The total amount of these weights must be equal to the true weight of the body, for, acting under precisely the same conditions, both have produced the same effect. The exact weight is also learned by the common practice of weighing a body first in one pan and then in the other of the balance.

IMPROVEMENTS in nails are still in order. The latest "new nail" is a sort of combined screw and nail, but partakes most of the character of the last-named appliance. The nail is circular, and carries a screw thread, in the form of a very coarse spiral, only once traversing the circumference of the nail in the course of its entire length from head to point. This nail is inserted in the ordinary way, by the aid of a hammer. Its superiority in holding power will be admitted by any mechanic. Thus, if the new nail be driven through two pieces of wood, A and B, in the order named, it would be necessary, in order to tear B from A, that either the iron or the wood screw should be stripped, the other alternative—retrogression of the screwed nail—being practically impossible of occurrence.

THE reason for making champagne corks by hand is curious and interesting. The cork machine is provided with circular knives of razor-like edge. Now, the crude cork is so rough and hard that if it were applied to one of these rapidly revolving knives, the knife would at once be ruined. So crude cork that is to be cut by machinery must be softened in a steam vat. It comes out almost pulpy and cuts like cheese. But the steam takes the "life" out of the cork. Its elasticity is gone, never to be recovered, and when the machine-cut cork is driven into a bottle the cork tends to shrink and permit leakage. Furthermore, the machine-made cork is mathematically round, while the necks of bottles are more or less irregular. As the machine-made cork has lost its elasticity, its smooth, round surface cannot swell out to fill any irregularity in the neck of the bottle, and here is another source of leakage.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 26.

79.—Does the act of digestion of food influence the rate of the pulse?

Yes; the condition of the digestive system exerts a marked influence upon the circulation. According to Edwards there is an increase in the pulse of from five to ten beats per minute after each meal. Prolonged fasting diminishes the frequency by from twelve to fourteen beats. Alcohol diminishes, and afterwards accelerates the pulse. Coffee accelerates it in a marked degree. It has also been ascertained that the pulse is accelerated to a greater degree by animal than by vegetable food. These variations have long been recognised by physiologists.

80.—What is the best method of observing the transit of Venus, and is any useful object served by such observations?

For work of this kind, the proper means to be employed are undoubtedly photographic. It is true that some difficulty has been experienced in interpreting the results obtained by such attempts as have hitherto been made to photograph this transit. But there can be no doubt that, by producing the photograph on a sufficiently large scale, all such difficulty would vanish. Considering the circumstances of the case, it should be possible to make the photographs of almost any size desired; and it may be expected that, when the next transit occurs, photography will be the only recognised method of recording the observations. Increased accuracy in the computation of parallax will result, and the transit may be rendered, what at present it can scarcely be called—a highly accurate method of determining the distance of the sun.

81.—What is colloid material?

Matter in the colloid is distinguished from matter in the crystalloid state by the greater complexity of its molecules—these containing, as a rule, a large number of chemical atoms. All colloids are tasteless—a striking example of this fact being found in caramel, a colloid body produced by heating the crystalloid cane sugar. Another characteristic of colloid bodies, which include such materials as gum, starch, dextrin, tannin, gelatine, and albumen, is their tendency to gelatinise, with the retention of water of gelatinisation, corresponding in some respects with the water of crystallisation that is retained by many crystalloid substances. The most important distinction between colloids and crystalloids lies, however, in their different rates of diffusion. Thus, hydrochloric acid is ninety-eight times, and cane sugar (one of the least diffusible of crystalloids) is fourteen times more quickly diffused than caramel. Dialysis is a very remarkable operation, dependent upon the fact that crystalloids, soluble in water, have the capacity of diffusing through a septum of insoluble colloid material, such as parchment paper. It is supposed that the water of gelatinisation, retained by this colloid in a state of loose combination, forms the medium in which transfusion of the crystalloid takes place.

82.—Excepting at the poles, could weighing and other operations be carried out independently of the influence of the earth's rotation?

The equatorial velocity of rotation of the earth is about 1,000 miles per hour, and the diminution of weight there resulting from "centrifugal force" amounts to one two hundred and eighty-ninth part. It is *practically* impossible to eliminate this influence in weighing operations, but it may be of interest to remark that in a train, balloon, or ice-boat, running westwards, at the rate of sixty miles per hour, between the 86° and 87° parallel of latitude, the desired result could, theoretically, be attained—the rotatory motion of the earth would be exactly compensated by the motion of the train.

83.—What is the greatest mechanical effect that is practically obtained with a pound of fuel?

1 lb. of coal furnishes, through the agency of a steam boiler and engine, an amount of energy equal to raising 8,000 lbs. to a height of one foot—that is a quarter of one actual horse power. 1 lb. of crude coal oil yields in a similar manner 15,000 ft. lbs., and 1 lb. of coal gas, in a gas engine, yields 22,000 ft. lbs. of useful energy. If gunpowder be regarded as fuel, the combustion of 1 lb. yields 77,000 ft. lbs., stored by the momentum of the cannon ball. But, with the exception of the cannon or rifle, no artificial combination is known that furnishes useful energy with an approach to the efficiency of the animal mechanism.

84.—Is it possible to voluntarily arrest the action of the heart?

It would seem that certain individuals have the power of temporarily arresting the action of the heart, by a voluntary suspension of respiration. The most remarkable case of this kind on record is that of Colonel Townsend, quoted in Denglison's Human Physiology. Colonel Townsend was able to arrest respiration, and the action of the heart, so completely as to perfectly simulate death. When in this condition his pulse was not perceptible at the wrist, nor was there any clouding on a mirror held before his mouth. On one occasion, in the presence of several medical men, he remained to all appearance dead for half-an-hour; the functions of circulation and respiration afterwards gradually becoming re-established.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

91.—What is supposed to be the cause of the aurora borealis?
92.—How are the little electric batteries of thimble size constructed?
93.—Is homœopathic medical treatment based on reasonable theoretical grounds?
94.—How is it that heavy particles of water are suspended in the air in clouds?
95.—What is the highest temperature that can be endured without injury by the human frame?
96.—What causes the "Will-o'-the-Wisp"?

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.

Or through any Newsagent.

BOOMERANGS AND FLYING MACHINES.

Incidentally to his investigations respecting flying machines, Professor Langley of the Smithsonian Institution, has been making some most interesting experiments with boomerangs, which he regards as illustrating certain problems having reference to aerostation.

For this purpose he recently made to order a number of ideal boomerangs, based as to shape upon mathematical principles. Ordinary boomerangs, such as are employed by the natives of Australia, would not serve. Professor Langley has fifty of them, manufactured for actual use in the land of the kangaroo, at his disposal, but not one in the lot will do what the typical boomerang is advertised to do, namely, return to the thrower. They are all very rudely shaped, curved sticks, doubtless effective as missiles, but nothing more. No wonder that travellers in the island continent have declared the return boomerang to be a myth. Yet it is not so.

These boomerangs of Prof. Langley do return. One of his assistants, Prof. Otis T. Mason, the famous anthropologist, has attained such expertness through practising with them that, although a small man, he can throw them 100 yards and they will come back to his feet every time. Several sets of them were made on different patterns for trial. The perfect ones are each a flat strip of hard wood, bent in its own plane, at an angle of about 120 degrees, one-third of an inch thick, and slightly tapered towards the rounded ends, thinned gradually to sharp edges in every part, and polished. Two pieces, neatly mortised together, are used to make the angle. Such is the ideal boomerang, a small counterfeit of which, cut out of cardboard, will afford an amusing illustration of the principle involved. The real instrument is held by one end horizontally and "skimmed" through the air.

Perhaps you have seen some other adept in sleight-of-hand throwing cards from the stage into the gallery of a big theatre. It is a remarkable feat, and yet the only difficulty lies in so flinging the card that, upon leaving the fingers, it shall revolve once in its own plane. If it "wobbles," the resistance of the air will stop it. But once started revolving in the manner described, it must keep on flying edge first until the force which propelled it is used up. The boomerang does the same thing if similarly cast. Being sufficiently heavy, of admirable shape for throwing, and yet thin and sharp-edged, it travels wonderfully far; but why does it return?

Nothing could be more simple. Did you ever see a boy at school place a scrap of cardboard beneath his thumb nail, snap it with his other forefinger and send it flying across the class room? Strangely enough, when it has reached the end of its flight, supposing that it has struck nothing, it starts to come back. A conjuror will in like manner throw a card half way across the theatre and it will return to his feet. It does so because it is easier for it to do that than to do anything else. Being light, the air sustains it somewhat, and, gravity acting upon it, it slides down the same plane by which it went up. To go in any other direction than back to the thrower, it would have to change its plane, turning its edge in another direction. Try it yourself by skimming a playing card part way across the room, and will find that it returns to your feet.

The principle of the boomerang is the same. It is not the curve in the stick that causes it to come back. The instrument is made in that shape merely because it can be more easily revolved in its own plane than if it had any other form. Because it does so revolve, meeting the least resistance by the air, it travels the maximum distance with a given expenditure of force, and, if properly cast, returns like the card to the feet of the thrower. It flies so swiftly, being light in proportion to its surface, that gravity has not much time to act upon it. Of course, when flung a great distance, it must reach the ground before getting back to the thrower, unless aimed somewhat upward.

How did the "black fellows" of Australia, lowest of savages in the scale of humanity, discover such a remarkable principle as that of the boomerang? Doubtless by accident. They have found the weapon useful for killing ducks and other water fowl on the marshes, where missiles thrown were not easily recovered. If the game was struck, the stick fell with it, and the hunter could wade in and recover both. Otherwise the boomerang came back and was ready for another shot. Properly made boomerangs would do this, at all events, and some of those possessed by the natives must be constructed on more or less correct principles; but most of them are merely bent clubs somewhat resembling the "rabbit sticks," which the Zuni Indians fling at jack rabbits, breaking the legs of the animals as they jump over the tall prairie grass. On ancient Egyptian monuments men are represented in the act of throwing curved sticks. Probably they were employed for killing big birds in the sedges of the Nile. There is no reason for supposing that they returned. Owing to its shape, the trajectory of the boomerang is a sweeping oval.

Prizes for Amateur Photographers.

We include among our readers so many who practise photography, both for pleasure and scientific research, that we have decided to start a series of competitions, which we shall continue through the season if the interest is maintained. The first competition will consist of

Six Prizes.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co.) for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A camera for making enlargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a separate coupon, firmly attached thereto.

The last day for sending in photographs, slides, or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet Street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday, June 28th, 1892.

WHAT IS POISON?

A lecture delivered some little time since, before the London Institution, by Dr. Meymott Tidy, in which he explained "What is a poison?" contained much to interest the scientist. Toxicology is the science of poisons, and Dr. Tidy tells us how it came to be called toxicology. The Greek word from which it was derived meant a bow, and was used to signify not only the bow but also the arrows used with it. Dioscorides, in the first century, first used the term in connection with poison, which was at that time associated with the art of smearing the arrow heads used in warfare. Thus the meaning of the word tended to enlarge itself, trying, as words do, to keep pace with scientific progress. In that Greek word *toxon* was to be found not only the derivation but the early history of poisoning.

A grim interest gathers round the history of poisoning. No doubt the first poison employed was that obtained from the snake. The subtle serpent first taught the art to man, but in those early days it was used in open warfare. But man grows wiser, and perhaps wickeder, and it was reserved for later times to taint the cup of friendship with the deadly venom. Was the suggestion too wild that if it had not been for the invention of more effective means of slaughter, the chemist would still have been called in to aid in the art of poisoning weapons? But if he had missed his chance in that respect, he could still look back to the early days of toxicology as the cradle of science.

This art of poisoning arrows went back to quite prehistoric times. Mythological legends tell how Hercules dipped his arrows in poison to slay the Hydra, and how his jealous wife. clothed him with the coat of Nessus, wherewith she vainly hoped to regain his affection, but only occasioned the sufferings which destroyed him. Strange it is to note how old is the knowledge of the poisonous nature of putrid blood, and of putrid animal fluids generally. This was recognised in very early times. The blood of a red-haired woman was regarded as especially poisonous. And up to almost recent times blood itself was thought to be poisonous. A king of Egypt was said to have been killed by drinking bullock's blood, and not more than a century and a half ago Blumenbach induced one of his students to drink the same, while he and his class stood by to watch the symptoms.

The stories of Circe and Medea, of Drusilla and Locusta, of Tiberius and Nero, of Toffana and the Medicis, were tempting, but were not the subject of the lecture. Dr. Tidy confined himself to the question, "What is a poison?" The law has not defined it, but the law frequently demands a definition from scientific witnesses. The popular definitions of a poison are none of them sound, much less scientific. He had searched every dictionary he could put his hands on and believed that the definition in every case amounted to this: That a poison is a drug which kills rapidly when administered in small quantities. But many poisons do neither the one nor the other. The terms "small quantity" and "rapidly" were about as definite as the classical piece of chalk. "Here," said the lecturer, holding up bottles containing nearly an ounce of each, "are oxalic acid and sugar of lead, in about the quantities necessary to be taken to make sure of a fatal result. But we should hardly call these small quantities. And yet these are certainly poisons. Moreover, many of the most certain poisons are very slow in their action."

Dr. Tidy defined a poison as "any substance which, otherwise than by the aid of heat or electricity, is capable of destroying life by chemical action on the tissues or by physiological action on the organs of the body. There's a good lot of it," he added, "but I can't get it into fewer words." Of course, he explained, mechanical means were excluded. You might kill yourself by swallowing pins, but pins were not poison. Nor is a substance a poison which destroys life by merely blocking out that which maintains life. Then he took two glass jars, one containing carbonic acid gas and the other nitrogen, and dipping a taper in each, showed that it was easily extinguished. "So would you go out," he said, "if you were introduced into either atmosphere. But the nitrogen is not a poison. With 20 per cent. of oxygen in it you can live quite easily; but neither 20, nor 40, nor 60 per cent. of oxygen would enable you to live in an atmosphere of carbonic acid gas, which is a poison." He proceeded to say that nature hates classification, but he must give illustrations of three classes of poison. First, he alluded to sulphuric acid, and showed a part of a stomach charred by the action of this poison. The charring effect of sulphuric acid was explained by the familiar experiment of pouring sulphuric acid on a thick solution of sugar, showing that the effect of the oil of vitriol was to abstract the water, and thus to cause the "charring." The stomach dies. That is molecular death, and this death soon extends to the rest of the body.

Carbonic oxide furnished an illustration of a second class of poisoning. A bottle of this gas was lighted at the neck, and burned with a blue flame, the same as that seen just over fire stoves. This gas is always present in coal gas to the amount of 5 or 6 or 7 per cent., and gives it its poisonous character. Dr. Tidy does not think carburetted hydrogen burning in the gas jet is at all poisonous. He thinks all the poison is in the 5 or 6 per cent of carbonic oxide. How does it destroy life? In this way: The active agent of our blood is the red colouring matter called hæmoglobin. This substance abounds in wonder. It is the most marvellous compound, chemically, with which we are acquainted. To live and thrive and flourish we must get albumen and albumenoids. We cannot form these ourselves, but the plant can. The power of building up albumenoid substances is limited to the plant laboratory. Man has the power to change one albumen into another. He can convert albumen into peptone, for example; he can break them up into albumen lower in the scale; but he cannot go higher—*with one exception*. That exception is hæmoglobin, the red colouring matter of the blood. This hæmoglobin, which comes on the scene through a stage opening of which we know not the whereabouts, has a strange property. As a rule, substances which combine with oxygen with the greatest difficulty can be separated from it with the greatest ease; and, conversely, substances which combine with it with great ease can be separated from it only with the greatest difficulty. Gold is one of the most difficultly oxidisable of bodies, and its oxide is most easily reducible. Potassium and sodium, on the other hand, combine with oxygen with the greatest case, but it required the genius of a Humphry Davy to separate them. Hæmoglobin is an exception in this respect also. It combines with and separates from oxygen with equal facility.

The life of man depends on the perfection with which hæmoglobin performs its function as oxygen receiver, oxygen carrier, and oxygen deliverer. But when a man takes carbonic oxide, hæmoglobin combines with this almost as easily as it does with oxygen, and, having taken it, the carriage is full; it cannot take up any oxygen. But, worse than that, it cannot get rid of the carbonic oxide; the carrier cannot unload. In scientific phraseology, the combination of hæmoglobin and carbonic oxide is a comparatively stable compound. The man dies because the sequence of oxidation is interrupted.

Strychnine was the third illustrative poison introduced.

This poison was said to destroy life by physiological action. "And what do I mean," said the lecturer, "by physiological action? I mean just simply that I don't know what I mean. Not knowing how it acts, I use the phrase physiological action to conceal my ignorance. It would never do to say we did not know how drugs act, so we say it is a physiological action. But we know one thing about the action of strychnine. We can tell by means of the spectroscope that the fits resulting from the administration of strychnine coincide exactly with the abstraction of oxygen from its compound with hæmoglobin. Why it kills we do not know, and let me remark that it is one of the highest forms of knowledge to know exactly the limits of our knowledge. In fact, the term physiological action no more explains death by poisoning than the term catalysis explains fermentation."

But can chemical investigation throw no light on the reason for the poisonous character of certain elements and certain compounds? Given that we know many facts about phosphorus, for example—its atomic weight, its relations to the periodic law, its spectrum, and so on—ought we not to be able to foretell, in some degree, its action? This subject was studied, first by Blake in 1841, and afterward by Rabuteau in 1867, and by other investigators. At first it was thought that the physiological activity of the elements increased the ratio of their atomic weights, but it was afterward noted that the reverse was the case in certain groups, and the end of the researches was the conclusion that neither in regard to elements nor compounds could any reliable rule be formulated. In inquiring into this subject further difficulties occur in the strange allotropic forms of certain elements and the isomerism of the organic compounds.

Illustrations of these conditions were adduced in yellow and red phosphorus, the first of which, Dr. Tidy said, would be fatal in 2 grain doses, while of the other an ounce might be taken without injury, as far as he knew. Ozone was another mysterious body. Every one knows that oxygen is the great life-preserver and life-sustainer. Ozone is oxygen in which three atoms are condensed into each molecule instead of two. But if you put a frog into ozone, into this condensed oxygen, it will soon close its eyes, its respiration will fall rapidly, and it will die simply for want of oxygen. As an illustration of isomeric bodies take these two substances, morphia and piperine, send them to a chemist for analysis, and his report will be that they are identical in composition; and yet the one is of all things in the world that which is most calculated to send one to sleep, and the other is of all things in the world the compound to keep you awake.

In ancient times the arts of witchcraft, medicine, and poisoning were bound up together. The Greek word pharmakist was used to signify dispenser of medicines, a witch, and a poisoner. One of the great services that science has rendered to mankind has been to separate these notions. The modern pharmacist no longer requires the stuffed crocodile to watch over his incantations, to aid in the composition of his medicines. And science has done more than this. It has rendered impossible the secret villainies of the old poisoners. It follows the traces of secret treachery with a blood hound scent, and will ultimately tend to repress entirely the crime of poisoning.

Prof. Roberts-Austen F.R.S., in referring to the difficulty which formerly existed in measuring very high temperatures, showed the point at which gold passes from the liquid to the solid state to be 1,045° C., and of palladium 1,500°. The modern instruments are capable of measuring up to 2,000° C. with approximate accuracy.

ELECTRICITY ANALYSED.

It is a favourite saying of Zollner's that the great difference which he found between educated and uneducated people was that the latter accept all the phenomena of nature as matters of course, while the former find themselves encompassed with riddles, seeming contradictions, and wonders. Just as, until Newton, no one wondered that the apple fell to the ground, so to-day the great majority of people discourse about electricity, magnetism, electric currents, electric machines, etc., in so familiar and matter-of-fact a manner as to intimidate inquiries, without realising how very meagre is our knowledge of the essence or substance of electricity and its relation to other natural forces or manifestations of force.

It is true that in physics we talk about positive and negative electricity, about an electric fluid, etc., but this "fluid" is only a word which serves our purpose in the absence of more exact knowledge. Is there such a thing as electricity? And, if so, what is it? What is this puzzling, invisible, imponderable so-called fluid which courses through the telegraph wires? What force is in the cable that connects the machine with the dazzling electric light? There is nothing on the wire to indicate to the naked eye whether the electric current flows through it or not. There is no change of colour and no appreciable change in its taste or temperature; nevertheless, a wonderful something from without operates in it. If a watch is held near it, under certain conditions, it will be stopped and permanently damaged. If the wire be filed thinner in any spot, it becomes heated to redness. If the wire be cut through, a shower of sparks spurt out, accompanied with flashes of light dangerous to life, and in all respects resembling lightning. The mystic force disappears as rapidly as it comes, traversing thousands of miles in a second. These are facts with which every schoolboy is acquainted, but the more familiar the phenomena, the more painful for the thinking man is the uncertainty as to its essence and its relations. An electric stream flowing through a wire is interrupted if the wire be cut: and in 1831 Faraday made the remarkable discovery that at every opening and closing, an electric current of short duration was set up or "induced" in every metallic body in the neighbourhood.

This appeared at first glance to indicate that the electric force was capable of operating at a distance, without any channel of communication. Faraday, however, was convinced that this was no adequate explanation, but that the transit of the fluid was accomplished by the mediation of some unknown conductor. But if electric induction is dependent on some medium in space, the question arises, should not experiments afford evidences of it, by enabling us to determine the speed of transit, and further what is the transit medium? Federson was the first to discover that the transit of electricity from point to point was not instantaneous, and recalling what was said above as to all metallic bodies in the neighbourhood of the cut wire becoming subjects of induction, is it not reasonable to infer that the operation is conducted by a species of waves of motion? An analogous instance to the transit of electricity through space is afforded by the following very familiar phenomena: The reader will almost surely have remarked that on opening the door of a room suddenly, a hinged window on the opposite wall sprang open. To the man unaware of the existence of air, the phenomena must necessarily suggest the idea of force acting at a distance, but with our knowledge of air and its properties the explanation is simple; the opening of the door sets in motion waves of air, which, reaching the window, act mechanically upon it.

Electric induction is now explained by a similar hypothesis. The principal worker in this field has been

Professor Hertz, now of the University of Bonn, whose experiments and deductions are of epoch-making significance, and whose views may be concisely stated as follows: We may now deem it extremely probable that there is no such thing as electricity or magnetism in the sense in which it has been hitherto conceived, viz., as a certain imponderable fluid, attracting and repelling from a distance, but rather that light, heat, magnetism, are electrical phenomena; or otherwise that light, heat, electricity, magnetism, are kindred phenomena, all depending on the motion of the ether, which we think of as invisible and of incalculable tenuity, penetrating all bodies and filling space. It is clearly evident that electric induction is not immediate, nor due to a force springing through space from point to point, but that it requires measurable time in transit, and that its extension is similar to that of light and heat, viz., by waves of motion.

We have no space here to enter on the details of Hertz's interesting investigations as to the relations of electricity to heat, light, optics, etc. Suffice it to say that his discoveries have created considerable excitement in scientific circles, opening up a vast intellectual perspective. In all cases, wherever light, heat, and chemical action are operative, he has rendered it evident electricity is also active. Let us imagine that at this moment the sun, hitherto darkened, shines forth in its brilliancy; thousands and tens of thousands of waves of ether burst forth, permeating space in all directions; a small portion of these waves reach the earth; each single wave is made up of portions of waves of all sorts, some with especially short, some with especially long waves, some powerful, some weak, some polarised, some unpolarised, comparable to the varying waves of sound which fall on the ear when a band strikes up. The very short waves, with wave lengths the thousandth part of a millimetre, exert themselves in chemical action, as on photographic plates, and in the functions of organic life; those of greater wave length are apprehended by the eye as light, appearing, according to their length, as violet, indigo, blue, green, yellow, orange, red. They strike on the retina and generate the perception of light and colour. Even waves of this length generate a measure of warmth in their activity, and all these, along with waves whose lengths can be measured by metres and kilometres are of electric nature, while the waves of utmost length manifest themselves probably in the Northern Lights, which flash from pole to pole, similar to what is to be observed on the planet Venus.

If the question is now again asked: What is electricity? we may reply advantageously, in the words of Jokai: A thing of which we know a little more than nothing, and a little less than something. A little more than nothing, for we know that it is of the nature of light and heat, extending itself, like them, in waves of motion. A little less than something, for of the essence of electricity itself, whether static or dynamic, we are still absolutely in the dark. There has been no want of either theories, but the fundamental tendency of the age is to reduce all phenomena and forces to the fewest possible primaries; and it is not improbable that this will be facilitated by the wave theory of the so-called ether. The problem of gravitation, too, which was so long regarded as a force acting from a distance, is now equally attributed to the agency of a medium. In his efforts to demonstrate the oneness of all natural forces, the physicist is not likely to be led astray, even although the cognition of force presents one of those world problems the solution of which must for ever escape us; aye, although, as a final result of the most exact investigation, it should for ever be denied to him even to assert decisively: "It is only a force, and the ether is its medium of transmission."

POPULATION OF THE EARTH.

Exactly how many people there are in the world it is impossible to say, since no census is taken of many populous countries, like China, while the number of people who live in the jungles of Africa can only be guessed at.

As long ago as 1866, Behm, a leading German authority, estimated the population of the earth at 1,400,000,000.

In 1880 the same authority set the figures at about 100,000,000 more. He did not base the new estimates on the natural increase of the people of the world, but explained that more accurate figures and estimates had enabled him to guess more closely.

Two years later Mr. Behm estimated the earth's population at 22,000,000 less than in 1880, the decrease being accounted for by the fact that new investigations had compelled the reduction of the estimated population of China from something over 400,000,000 to about 350,000,000.

Probably the estimate for the year 1891, made by a learned German statistician, is the most nearly accurate of any yet made—1,480,000,000. We roughly gave these figures as 1,500,000,000 in a recent issue of SCIENCE SIFTINGS.

It is believed that the world's population is increasing at the rate of nearly 6,000,000 a year.

The most populous continent is Asia, which contains two countries—China and India—whose swarming millions outnumber the people of all the other countries of the continent.

The most densely peopled continent is, of course, Europe. The number of people in Europe is known with a great degree of accuracy. There are about 360,000,000; and the continent which accommodates all these people is so small that there are upon it an average of ninety-three people to the square mile.

The people upon the two continents of North and South America, without the arctic regions, are less than 122,000,000 in number, or only eight to the square mile.

If America were as densely populated as Europe, this half of the world would have a population of nearly 1,400,000,000—practically the same as that of the whole world at the present time.

TO OUR READERS.

A Two-Guinea Portrait Free.

The Proprietors of "Science Siftings" will present a beautiful porcelain portrait, free of any charge whatsoever, to every reader of the paper who forwards three annual subscriptions of 6s. 6d. each, or six bi-annual subscriptions of 3s. 4d. each. These may be canvassed among friends, and a triple object will be served: the friends will be enlightened, "Science Siftings" will be helped onward, and a free portrait secured by the canvasser:

The liberality of this offer will be appreciated when we state that these portraits cannot be procured in the ordinary course of business under two guineas each. They are artistic portraits, beautifully finished by hand, on porcelain panels, measuring the size of this page (10 inches by 8 inches).

Another Offer.

Our object in making this offer is to cause people to talk about "Science Siftings," and thus to promote the circulation. It will be manifest that we lose money by each portrait. This, however, makes people talk about the portraits, and, hence, about the paper. We will, therefore, send to those readers who cannot induce their friends to subscribe to "Science Siftings," a portrait on receipt of 7s. 6d. to cover the cost of the porcelain panel and postage. The portrait will then be free.

Send a good portrait with the order, and the clearer this is, the better the enlarged porcelain portrait will be.

NOTE.—Owing to the large demand, we have been enabled to reduce the price of these Portraits.

A SIMPLE PROCESS FOR COLOURING PHOTOGRAPHS.

The following is a process by which coloured photographs can be made without any knowledge of drawing or painting.

Take any unmounted photographic print which it is desired to colour, and place it on a pane of glass, the face towards the glass. In this way the image will be seen through the back of the paper.

With an ordinary pencil mark on the back of the print a rough tracing of the outlines of the photograph, marking the places where the colours must afterward be applied. When this tracing has been made, remove the photograph, lay it on blotting paper, and apply the colours to the back of the print. The colours should be spread on in flat tints, it not being necessary to use demi-tints. For example, a flesh tint is put on the face, and black or brown on the hair ; if the picture is a landscape, the trees are coloured dark green, the sky part blue. It is important to use strong colours, which will show through the paper better. After this operation is finished, and when the colours are dry, the photograph is rendered transparent, as follows :

First prepare the following solution :

Essence of petroleum or benzine	10 parts
White vaseline	1 ,,

The vaseline is dissolved in the liquid, and then the mixture is ready for use. Then the photograph. which has been coloured previously, is placed on some sheets of white paper, and the back of the picture is saturated first, pouring the solution on it, and rubbing with the finger to cause the mixture to penetrate, first the colour and then the paper. The print is then turned face upward, and this side is saturated in the same way.

After this operation the paper becomes oily and transparent, and the colour begins to show through.

It is left to soak thus for an hour or two, then both faces are rubbed with linen until no oily spots can be seen, when the proof is placed on white paper.

The operation is then completed, and the proof has only to be pasted on cardboard, the same as other photographs. But, as the paper is still saturated with vaseline, water paste will not answer, and some kind of varnish will have to be used.

This process of painting, which can be used by anyone, gives very beautiful effects.

Colours which are thus applied to the back of a photograph give it a tone of admirable freshness, and the vaseline mixture brings the image out. Besides, as the colours have the thickness of the paper to pass through, they are greatly softened, and thus approach nature. The variations of the tints will be seen, by transparency, when looking at the picture.

As to the colours, any that are at hand can be used, whether water colours or oil colours. The essential point is to choose the most strong colours, rose, green, etc., and to put on only a very thin layer, as otherwise the vaseline cannot pass through it. If oil colours are at hand they will be better, and the result obtained will be much prettier, for they are more striking, and the vaseline passes through them better. Pastels or coloured crayons can be used, but oil colours are greatly to be preferred to any others.

If it is desired to save, and not to colour, the photograph, its outline can be traced off on ordinary white paper, and the colours applied to the white paper as before described. Then it is only necessary to paste it on the mount behind the photograph, care being taken to render the latter transparent, nd the two must be so placed that their outlines will agree. The effect obtained is the same, and gives very pretty results, not showing in the least how they are done.

a

WHERE DOES LIGHT GO?

The question put where a transparent surface has been made translucent, as in the case of a cut, frosted, or ground surface given to glass, is applicable to light generally. Where does light go ? What becomes of the darting, shooting, piercing ray ? These questions are equally to the point, whether we accept the theory of emission or of undulation, but particularly as to the latter.

To obtain as full a comprehension of the simple object as possible, let us, for the moment, consider that the expression of movement of light is in a right line—a right line only. This is an effect on the senses which we may say we know practically. Undisturbed, so far as we can calculate, the movement will go on infinitely and for ever; but when disturbed, we call the manifestation deflection (bent as to course), refraction (broken as to course, or a violent deflection), and reflection (doubled back as to course, or the most violent action to which light is susceptible).

Now, if we imagine light to be a solid bar, we will observe, on the basis of what is here advanced, that it might perform all the movements that we are ascribing to a single ray of light, and, if properly projected, as light is, it might go on indefinitely, bending, coiling, and twisting through all creation. But we always conceive the idea of light by multiples—we speak of a ray when we really mean a whole bundle of rays, how many it is ever impossible to enumerate. So, continuing the figure of the bar, let us fill our horizon with an infinite quantity of bars, projected from an everlasting and ever moving force, as they go on bending, coiling, and twisting, until the sphere of our surrounding is filled and bar meets bar, each with the projection of the other, derived from the same imperial source, and propelled by the some majestic energy. Where do the bars go ? On the light principle they cease to be bars, as light ceases to be light when motion becomes rest. With no means of progress or continuance except upon each other, we have come to the inevitable halt of the senses over the conception of an irresistible force and an indestructible body, for bar thus circumstanced cannot displace bar, and with the cessation of action the bars are no more on the principle of light. It is the Greek of nature meeting Greek with the natural product of nihilism after action. In this way light is said to be decomposed.

The same analogy may be carried into our conception of sound, where two identical vibrations neutralise each other and produce silence, and the same with air, the same with water.

Then, says a correspondent, may we not account for the loss of light as exhibited by the photometer in transmission, through a mass of prisms and reflecting surfaces, of the ground glass or the frosted globe, as perfectly natural ? For, in the passage, ray has met ray and become extinct. This warfare is eternal—it is going on everywhere. Otherwise the universe would be all light, and primal sources would in no way be needed to combat the everlasting tendency to what is darkness to the senses.

Thus, continues the same authority, then we may reasonably conclude that the loss which we experience in the transmission of light is simply a constant tendency of one ray to kill another as nothing else can, and as the prisms and surfaces are multiplied the loss is increased, and *vice versa*. Such at least appears to be the law of the elements that are inherent in matter and of a primary character.

GUN-ARMED ANTEDILUVIANS.

A minute description of an extraordinary fossil was recently submitted by Professor Waskish to the members of the Paleozoic Society, of Stillwater, Minnesota. It was discovered solidly embedded in a cliff of white sand-stone, a deposit, undoubtedly, of the tertiary age, and owing to its compact surroundings was preserved almost entire and intact. An expert examination and careful historical and zoological research, so far as the society is able to go, leads to the supposition, not yet, however, a confirmed or indisputable belief, that the skeleton belongs to the long extinct genus Dinotherium, a quadruped of gigantic proportions, and of which only fragments have heretofore been found ; also, that a tusk found in Stillwater in 1858 was a portion of the same genus of prehistoric monster. As to this isolated tusk, however, its incomplete or scanty loose covering had permitted its disintegration to such an extent that only portions of the same had been preserved. The tusk or horn was originally, it would appear, some 4 feet in length and at least 6 inches in diameter at the base.

A portion of this relic is now in the collection of the State Historical Society at St. Paul, and is pronounced as being ivory equal in all respects, except the changes produced by ages of time, to that taken from the elephant of our day. The big mastodonic remains are evidently those of a member of the order carnivora, judging from the structure and size of the teeth, the incisors being sharp almost to a point, while the molars are also trenchant and well adapted to the crushing of bones. The animal in size was some 12 feet in length, measuring from the base of the proboscis to the termination of the vertibræ column. The tail, as nearly as can be estimated, was some 5 feet in length. The skeleton itself is 7 feet 9 inches high at the shoulders and 6 feet 5 inches at the rump or hips, while the head is exactly 3 feet 4 inches in length, with a low, flat skull and powerful jaws.

The single tusk is 3 feet long, and at its union with the plate of the skull 6 inches in diameter, the diameter at the tip being about 5 inches. The tip, instead of being pointed, as is usual with corniculate animals, is blunt and also hollow, forming a tube or cylinder and suggesting a choke-bore gun. The inner surface shows in places marks of erosion effected by repeated and forcible contact with some flinty substance, the ivory being worn in parallel grooves to the depth of a full quarter inch. Professor Waskish is of the opinion that the horn or tusk was employed in the killing of the animal's prey, though not in the way of thrusting or impaling the object of attack, and here comes his plausible theory, which, if sustained, contributes to zoological knowledge a hitherto unsuspected fact, at once astounding and interesting—the fact that there once existed a genus of animals whose instinct and physical make-up led them to anticipate in a crude way the modern practice among mankind of using explosives or compressed air for hurling projectiles.

This tusk, he contends, was employed for firing prejectiles through the air. He says that the animal had a proboscis with which to gather stones of suitable size and to place them in the hollow of his natural tube ; that there was an exterior opening at the base of the tusk for the admittance of air, and that the creature possessed sufficient lung power for the expulsion of air to propel the projectile through the tube with enough force and to such a distance as to easily overcome and kill his prey. In fact he was a dead shot. The Professor believes, moreover, the Dinotherium shows a certificate that the beast comes from a fighting family, three of his ribs having been broken at some time and afterwards reunited by nature. The tibia (bone of the right foreleg) had also been fractured and, like the ribs, repaired by natural forces.

Except as before mentioned, the tusk shows but little wear. The skeleton head is perfect, except that two teeth are missing. The size and formation of the leg bones show that the animal was one of great strength and agility and capable of rapid motion. Whether or not the toes were armed with claws he doubts, but inclines to the belief that they were. It is also held that the creature's skin was very similar in texture to that of the rhinocerous, but as to that, of course, we have no means of positive demonstration. Professor Waskish states that doubtless other similar relics of this testimony from the tertiary period lie buried in Minnesota under the geological drift mentioned.

A SUN HYPOTHESIS.

Explosions of incandescent hydrogen are continually occurring in that star which we call the Sun, and it is not impossible that an eruption on a much grander scale may take place some day, which will cause the instant destruction of all forms of life on the earth. While such an event is not impossible, it is very improbable. In preceding ages, when our sun was at a much higher temperature than at present, and solar activity was much more energetic, such eruptions of incandescent gases were probably of common occurrence ; but certainly nothing of the sort has taken place since the animals composing the earliest fossils known to us existed, which, according to the teachings of geology, must have been millions of years ago. While we know very little of the constitution of the interior of the sun, it is most probable that it has now cooled down to a point which would prevent any such occurrence as has just been observed in the new star. However, we can comfort ourselves with the thought that, if such a sudden increase in the sun's heat ever does occur, the destruction of all life will be instantaneous, and "we shall never know what hurt us."

SIFTINGS OF THE STUDY.

My Experiences as an Executioner.

By James Berry.

(Percy Lund and Co : Bradford and London.)

There is much in this book that is useful, but a great deal on the other hand that might well have been left unwritten. Mr. Berry states in the concluding chapter of the work that he has no fancy for making himself "into a cheap show," an assertion which is hardly in keeping with the tenor of the book throughout, and with Mr. Berry's action in importing into the lectures upon which he is engaged much that is ghastly. Chapter X., "On Capital Punishment," is, however, unexceptionable in its tone, and will be perused with interest by students of criminology. There is one assertion in this chapter that it would have been well to support by reliable statistics. It is that "Whenever there is a series of executions, without reprieves, the number of murders decreases, and on the other hand, after a period in which several persons have been tried for murder and acquitted, or reprieved after sentence, the number of crimes appears to increase." We note that Mr. Berry does not advocate the abolition of capital punishment, but that juries should have a greater discretion in the qualification of their verdicts. This anyhow would be a step in the right direction. The book is worth reading by those who take an interest in the subject of murder, whether regarded as the result of cerebral disease, or responsible action.

SOCIAL SCIENCE.

FUSSY FOLK

It is related that at the battle of Salamis the quaint old cynic Diogenes rolled his tub up and down the street and thought he was beating the enemy. As a matter of fact, he was simply making an annoying and useless fuss, and the general situation was not, in the least, affected by his performance. He had the courage of his vanity, and that was all. The fighting was being done by others, while he was agitating himself with a foolish fancy. His rolling tub was not of the slightest service in any respect, and the noise that it made only tended to provoke ridicule and contempt. He was probably sincere in his belief that the result of the conflict depended upon his action rather than upon that of the eminent commanders of the embattled fleets, but his sincerity did not conceal or modify the absurdity of his position. His hallucination was not shared by others. The people know very well that he was not influencing the course of the battle so much as the smallest gust of wind that touched the sails of the contending ships, and when the victory was won nobody thought for a moment of awarding credit to him, or even of thanking him for his good intentions.

There are people in plenty who habitually follow the example of Diogenes at Salamis. They are systematically and persistently fussy, rolling their respective tubs in a most industrious way, with the idle supposition that events are thus being shaped and controlled. The idea never occurs to them that their energy is wasted for want of proper discipline and adaptation. They spend their time in superficial and irrelevant proceedings, and imagine that they are doing effective work when they are merely trifling with the matters in hand. Their activity counts for nothing because it is fidgety and indefinite. They never have a correct conception of the circumstances with which they are dealing, and do not know how to reach the vital points of a given subject or undertaking. Their methods are crude and inexact, and so they never bring distinct results to pass. They persuade themselves that they are achieving given ends by force of their fussiness, but they do not convince other people that such is the case. If they were gifted with the faculty of seeing their own operations as they are seen by the public, they would quickly realise that they are only the flies on the cart-wheel, having an absurdly exaggerated notion of their own importance, and a lamentably erroneous view of the means of progress and success.

The fussy individual is always and everywhere an egotist. He contemplates himself with the firm conviction that he is one of the choicest products of the scheme of creation. It is impossible to tell him anything. He thinks his knowledge is perfect in all relations, and scorns the suggestion that there may be a chance for him to learn a little more by listening to others who have had better facilities of study and experience. His dread of seeming to be ignorant upon any question is so great, that he will not permit himself to be advised by his best friends ; but he likes to give counsel so well that he rarely waits to be asked for it. The fact that his calculations and predictions so often turn out to be wrong does not lessen his serene and supreme faith in his own sagacity. He is ready with a plausible explanation of every failure of that kind, and never admits that he was mistaken. His self-esteem grows by feeding upon itself, so to speak, and instead of gaining in wisdom as he gains in years, he simply acquires an increased degree of bigotry and arrogance. The issues that people in general are disposed to investigate before pronouncing an opinion upon them he decides in an off-hand fashion, and tolerates no contradiction. He gets out of bed every morning with his mind made up concerning all the problems that may be presented to him during the day. There is no such word as reflection in his dictionary. He is a creature of impulse and instinct, who substitutes assertion for argument, and multiplies words to conceal his poverty of thought, as well as to emphasise his disdain for the ordinary rules of reason and discretion.

These self-satisfied and self-celebrating persons do more bustling and make less impression than so many grasshoppers. Their jerky and galvanic ways closely resemble the antics of those peculiar insects. They are constantly flitting hither and thither as if on errands of urgent importance and surpassing usefulness, but they never accomplish anything. Their diligence is of a description that hinders instead of helping the cause with which it happens to be associated. It causes distraction and confusion, and puts obstructions in the way of sensible and practical effort. The fussy man occupies more space and makes more noise than a dozen men of sound and judicious qualities. He is constantly placing himself where somebody else is needed, and his tiresome voice is heard to an extent that is at times a public nuisance. If such people were beneficial in proportion to their clamour, they would be the choicest blessings of society ; but the melancholy truth is that there is nothing profitable in their plenteous talk and their incessant fidgeting.

It is easy for a man to think that he is guiding a movement, when in reality he is only being borne along by it. His self-conceit blinds him to the fact that other men, who labour modestly and quietly, are accomplishing the results that he attributes to his own services. He is so completely absorbed in himself that he cannot see how much is being done by those who reject his methods and antagonise his theories. The rolling of his empty tub engages his attention so closely, that he fails to comprehend what is going on around him, and in spite of his clatter. When a desired end is reached he hastens to claim that he was the principal instrument of triumph, and that, without his co-operation, defeat would inevitably have ensued ; but the people are aware that he was nothing but an impediment from first to last. It does not matter which side of a controversy he is on so far as the value of his support is concerned. His vocal assiduity and his indefatigable fussiness do not commend his opinions to public acceptance. He is rated as a man whose information is always defective, and whose conclusions are never worthy of serious consideration. His blissful ignorance of his folly and weakness is amusing, when it is not provoking ; and he lives chiefly to show how a man can be happy though thoroughly inefficient.

Such a man is never conscious of the fact that his energy is expended in a fruitless manner. He thinks he is marching when he is only marking time. The true conditions of progress are unknown to him, and he deceives himself with false standards of utility. He fumes and blusters, and makes believe that he is doing wonders, but when he subsides there is no evidence that he has been in the conflict at all. His account of his deeds is refuted by the official reports. He magnifies his exploits in the style of Falstaff, but lacks Falstaff's forgiving habit of drollery. He never contributes anything to the interest of the situation, but is always monotonous and fatiguing. It is strange that his intelligence does not now and then suggest to him that he takes himself too seriously. He should be able to detect the signs of impatience that usually appear when he is parading his assumed wisdom, and telling people what they ought to do in the regulation of the affairs of society ; but if he ever discerns them, he never

heeds them. The privilege of being fussy is apparently all that he cares for, and he is content as long as he is not directly and absolutely suppressed. His audacity is equal to any emergency. He loftily disregards all hints to the effect that he is consuming more than his share of time, and absorbing more than his portion of atmosphere. There is no way to limit his fluency and his intensity. He is irrepressible. The drawbacks that discourage others seem only to stimulate him. He thrusts himself to the front in all contingencies, and will not voluntarily shut his elaborate mouth to make opportunity for anybody else to be heard.

This tub-rolling class is particularly at home in the field of reform. It finds its best chance there to display its fussiness in whimsical and impracticable propositions for the improvement for the existing order of things. The various philanthropic organisations of the period are all embarrassed in some measure by its presence. It is continually interfering with the plans and purposes of parties and societies that are honestly striving to promote the welfare of mankind. Wherever it can get a hold upon any such agency, there it proceeds to create discord and uncertainty. The only effect of its activity is to increase the obstacles that must be surmounted. It furnishes no element of strength or encouragement, but is altogether a source of trouble and disappointment. The philosophy of reform makes no provision for such an influence; it is alien to the conditions that prevail in all enterprises for the rectification of public wrongs and the vindication of public rights. There is no saving grace of goodness in the awkward and scattering efforts by which it seeks to justify itself. The most that it ever does is to profess adherence to a reputable cause from time to time, but its identification with such a cause is a disadvantage, as experience has demonstrated beyond all question, and as history teaches in a striking way.

We find the fussy people in politics, also, where they delight to play an active and persevering part. They make it their business to discuss doctrines and policies as if they alone were competent to determine the value and fitness of every proposed step in the process of government. If they are not consulted, they immediately proclaim their belief that things are going to smash, and that the fabric of liberty will not survive the next election, whereas if they were permitted to have a voice in the matter of arranging a campaign, they hasten to declare that the country is on the road to the greatest prosperity it has ever known. They adjust their views entirely in accordance with the personal consideration that it shows to them. The tests that they apply to platforms and candidates are simply those of pique and prejudice. They are not capable of looking at men or measures in a broad and impartial manner. Their own narrow and dogmatic opinions outweigh all the wisdom of the best statesmen, and they are not willing to concede that anything is correct which lies outside of their accustomed range of thought. This would not be so bad if they would pursue a temperate and proper course when their wishes are respected; but they are equally as fussy in that case. They roll their tubs with the same irritating and wearisome effect, whether they are pleased or displeased.

In all positions and in all respects fussiness is a misfortune. It does not perform any useful service even when it is devoted to useful objects. The practical and effective work of this world is done by men of quiet and deliberate methods. They never have time to be fidgety. It is their chief merit that they do not fritter away their energy in useless speech or locomotion. They appreciate the value of time, and the necessity of using it to the best advantage. When they talk it is for a well-defined purpose, and they employ the least number of words that will express their views or desires, They never seem to be in a hurry, and yet they are always busy. Their industry is steady and continuous, and every stroke counts, because it is properly directed. They do nothing by fits and starts, but everything by system and regularity. As a general rule they so arrange their work that it cannot crowd them if they are reasonably diligent. They are the masters and not the slaves of circumstances. That is to say, the tasks that they undertake do not overtax their strength, either of body or of mind, for the simple reason that they do not weaken themselves by useless exertion. That is the principal secret of their success. They improve their chances with a rational conception of the influences to be propitiated and the means required to avert disappointment. Fortune favours them because they are not tub-rollers, in short, and the lesson is one that should be carefully studied by all those who would know what is demanded of them as the price of victory in every occupation.

A MYSTERY OF NATURE.

Under the above heading we published the facts of the mystery of the phenomenon known as the "Barisal gun," which occurs in the delta of the Ganges. As an effort is now being put forward by the Asiatic Society of Bengal to try and solve this mystery, Mr. George Spencer, pharmaceutical chemist, asks if the following hypotheses will assist:—

(1) The detonations occur in a delta of 50,000 square miles in a flat alluvial plain intersected by a network of almost innumerable streams and channels and under a tropical sun, which infers that an enormous amount of aqueous vapour must be rapidly given off and as rapidly rise into the higher regions of the atmosphere.

(2) The detonations are always heard at their best in the clearest and driest weather, never during storms (or when the aqueous vapour cannot rise to the upper regions of the air). This would seem to show that the aqueous vapour, being capable of rising in clear weather to very great height, rapidly freezes and forms myriads of particles of ice, and that during the process of freezing spread over so large a surface, the innumerable "crackles," resulting from each particle of moisture frozen, taken together would form a detonation booming through the air and coming from "somewhere else." As is well known, water in the act of freezing always emits a noise; moreover, the friction of the particles of ice formed would also account for the same. Probably at the period of detonation great white clouds very high up can be seen, and the stillness of the neighbourhood, the absence of hills which would bring down the vapour, may all assist in this "mystery" being heard.

HELPFUL HINTS:

Being Answers to Correspondents.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

W. SIDNEY MAYNE.—The spring tide accompanying a new moon is higher than that accompanying full moon, because in the former case, both sun and moon lie, approximately, in one straight line passing through the place of observation and the centre of the earth.

AN INTERESTED READER.—We do not know of any reason whatever for regarding the tomato as injurious. In the United States, and some other countries, it is one of the commonest articles of food.

CHAS. WALKER.—You can repair the enamelled scale of your thermometer with a cement made from equal parts of wax and zinc

white. The ingredients should be mixed in a perfectly clean vessel at a temperature just high enough to melt the wax. The cement is then applied to the warmed scale, and will be found quite adherent after cooling. It can be scraped with a knife to a high polish.

S. L. M.—To make electrical amalgam for your frictional machine, melt one part of pure zinc in an iron or other crucible, add one part of tin, and afterwards withdraw from the fire, and stir with a piece of stick until solidification just commences. At this point add two parts of mercury, slowly and with constant stirring, which should be maintained until solidification takes place. Transfer the mass while still hot to an iron mortar, reduce to powder, and preserve in a stoppered bottle.

B. GRANT.—Steam, as it exists within the steam boiler, is a colourless and invisible vapour. Upon issuing into the open air it immediately loses heat by radiation, and condenses to fine particles or droplets of water. These particles reflect irregularly—technically "scatter"—light, and any object is visible by which a new direction is conferred upon waves of incident light. Hence the visibility of a cloud of condensed steam. Its whiteness arises simply from the fact that particles of the order of size in question reflect light of all colours in a precisely similar manner. The subsequent disappearance of the cloud of steam is due to the evaporation of the particles, *i.e.*, their solution in the atmosphere. The rate at which such particles of water are dissolved by the surrounding atmosphere depends, of course, upon hygrometric condition of the latter.

THOS. HENRY DAY.—Add a little permanganate of potash or "Condy's fluid" to the water. If it contains organic impurities these will be brought down by the permanganate in the form of a brown precipitate. Permanganate of potash in small quantity is not injurious to the system, and it is a good plan to add sufficient of it to impart a slight rose colour to drinking water that is suspected of contamination. The presence of this rose colour is an indication that all organic impurities have been oxidised and rendered harmless, "Nesler's reagent" can also be used as a test for nitrogenous matter but in this case the reagent itself is of a highly poisonous character.

G. HEMMENT.—You are quite right in your first communication. The images formed by the most powerful telescopes can be photographed, and these photographs can, in turn, be enlarged to any size desired. There is, however, nothing new in the suggestion. In your second letter, you remark of the sun and the moon that they are each distant from the earth by about 100 times their respective diameters, and you proceed to argue that, as the diameter of the sun is about 400 times that of the moon, there should be a similar difference in the apparent sizes of the two bodies. We recommend you to read up a little geometry, and become acquainted with the properties of similar triangles. The apparent size of any object is determined by the angle which it subtends at the point of observation.

G. BANGHURST.—The "seven stars," better known as the Pleiades, constitute a small group, including a very large number (at least 625) of stars visible by the aid of a powerful telescope. With an opera glass, from thirty to forty of the stars can be distinguished, this last being the number that was resolved by Galileo with the first telescope that he made. Ten stars of the group can be perceived even with the unaided eye, by those who are gifted with a very acute sense of vision. "Charles' Wane," otherwise "the Plough," or "the Great Bear," includes seven very bright stars, and owing to the fact that, in northern latitudes, it never sets, constitutes one of the most conspicuous objects in the northern skies. The two stars (β and α) that form the spur of the "plough" lie in a straight line which, if produced, guides the eye to the pole of the heavens, and to the polar star. For this reason β and α in the constellation of the great bear are often called "the pointers." See also p. 4, last issue of SCIENCE SIFTINGS.

THOMAS MASON.—Thanks for your communication, which is very interesting. The suggestion made by your friend to transform the energy of ocean waves into steam power, for the propulsion of ships, is very ingenious. His views on the subject of gravitation, etc., are, however, totally astray. We preserve his letters, and should he care to supply detailed sketches and descriptions of the machinery he suggests, we will give our opinion as to its practicability with pleasure.

YOUNG CHEMIST.—You will find no difficulty in attaching lables to your beakers if you first roughen the surface of the glass by grinding it with flour of emery.

A MECHANIC.—To remove the blue from steel work, wash clean with soft soap and then dip in dilute hydrochloric acid—say a 25 per cent. solution.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, $\frac{1}{4}$, 1/6; $\frac{1}{2}$, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. DALLMEYER "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, 25, NEWMAN STREET, LONDON. W.

DRESSES GIVEN AWAY!

25/- VALUE FOR **12/6** **THIS IS A FACT!**

We are selling FOR THE NEXT FEW WEEKS Splendid Dress Materials in Homespun Mixtures (Spring and Summer Shades) at ENORMOUS REDUCTIONS.

Dress Lengths, worth **25s.** for **12s. 6d.**, and other EXCEPTIONAL BARGAINS in Woollen Dress Fabrics.

Nothing Better For Travelling Costumes, for Seaside Costumes, for Sporting Purposes, for Morning Gowns. Can be Washed several times.

NOTICE TO LADIES.—Any Lady introducing to us customers for Dresses to the amount of £5, we will give a DRESS LENGTH at HALF PRICE, which may be selected from our patterns; or if the amount of business introduced reaches £10, we will give a DRESS LENGTH GRATIS. Carriage paid on all parcels above £1. Patterns sent post free. Write at once for patterns, kindly mention this paper, and address—

THE CO-OPERATIVE WOOLLEN MANUFACTURERS' ASSOCIATION,

GLASSHOUSE STREET, REGENT STREET, LONDON, W.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*; 3 *months,* 1*s.* 9*d.*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

LONDON : SATURDAY, MAY 7, 1892.

SCIENCE NEWS AND NOTES.

"Without doubting there can be no progress."
—DARWIN.

April has Gone,

but it has left behind a most remarkable record, and one that will be quoted for the next quarter of a century whenever April weather happens to be out of the common, or more fickle than the weather of that most fickle month usually is. Ten days before Easter we were in the apparently settled enjoyment of a season mild, sunny, and dry, the precarious foretaste of summer which commonly cheers for a brief space the later days of spring. Then followed the biting chill of winter winds, with rain and the very unusual addition of a snowfall worthy of December. The variations in temperature during the month were correspondingly wide, falling repeatedly to near freezing point, and again on the same day reaching a level of 40°, 50°, or 60°, and even higher. Needless to say these variations had a corresponding effect on the health of those exposed to them, especially those who were weak-minded enough to be lured by the summer-like temperature into leaving off heavy clothing for the sake of comfort, and thus abandoning their only safeguard—bodily warmth. These individuals were, of course, nipped—like the grossly deceived spring buds—and catarrhs, with more serious ailments supervening, were the order of the day. We shall no doubt be told that our warning comes rather late. Such, however, is not the case, for we may still expect the chilly nip that always comes about the middle of May. We reiterate the old maxim, "Never leave off a clout until the month of May is out."

Is Life Being Shortened

in the present day? If so, what is curtailing our period of existence? It is usual to ascribe decay to work and worry. Dr. Pye-Smith, who has had excellent opportunities of studying the matter, does not agree with the first part of the conclusion. The vanity of human nature is tickled by ascribing its disorders to such respectable antecedents as industry, energy, and intellectual activity. We must all have felt this, says Dr. Pye-Smith, when the obvious results of habitual idleness or gluttony are ascribed by a patient or his wife to an over-taxed brain or too strenuous devotion to business—especially in the public service. There is no fear of any one of us using our brains too much for our health, nor does mental labour or honest work of any kind interfere with health or shorten life a day. Even if it did, who would not rather be worn in use than rust in idleness? Who would not choose a short-spanned life filled full of action and of thought, of sorrow and of joy, of effort and endurance, of enjoyment of living oneself, and helpful service to others, rather than to wear out a tedious existence of monotonous ease.

Even if it Encroach on the Hours of Sleep

there is no reason to believe that work in itself is injurious. Nature will take care of herself, and irrepressible drowsiness will bring the needed rest if it be not driven away by artificial means. The evil results of excitement in the gambler, or of anxiety in the man who habitually lives beyond his means, are indirect. Such people go too long without food, and then eat more than they can digest, for their meals are irregular and hurried; or they take stimulants from time to time to excite them for the moment, or sedatives to give the repose which they have not fairly earned. It has become a commonplace of newspapers and of conversation, that the present age, the close of this nineteenth century, is fuller than any other of what is called "worry" and anxiety, mental excitement, over-strung nerves, and what not. It is gravely asserted that railways, and telegraphs and the modern race for success are shortening life in Europe generally, and in England and America in particular; that there is an enormous increase of what are called nervous disorders; and that the neurotic temperament or type or diathesis which now prevails is intolerant of the heroic means of combating diseases which were well borne by such dull-witted fellows as Steele or Johnson, and by the comfortable, prosaic, easy-living men who saw the mutiny of the Nore and Napoleon's army gathered to invade our shores. Dr. Pye-Smith tells us we are complimenting and pitying ourselves without cause.

What are the Hardships

of a railway journey to Bristol or to Edinburgh compared with those of a journey by coach? What are the trivial anxieties of a citizen's life from telephones and telegrams, rates and taxes, advertising druggists, and School Board elections compared with those of previous generations, when few men had not been robbed on the highway or otherwise put in personal peril, and when the citizens of many towns in the king's dominions had experienced a siege, a famine, or a pestilence. We may be sure that family troubles, misunderstandings and quarrels, disappointments and annoyances, bodily aches and pains, bills that cannot be paid, and accounts that will not balance, were just as common a hundred years ago as now—in the days of Horace or of Lucian, as in those of the *Spectator* and the *Rambler*. That life is in every way easier than it was a little reflection will convince us, and perhaps there is no better illustration of the fact than the contrast to annoyance, cold, and vexation which must have been constantly endured while trying to strike a light with a tinder box, compared with the ease, certainty, and rapidity of the lucifer match, or the still more rapid, easy, and brilliant electric light. The complaints we

now hear were just as common fifty or a hundred years ago; the nation has been going to ruin ever since it was a nation, the present generation has always been degenerate, more feeble, more vicious, and more diseased than any which preceded it; but at the same time more sensitive, more interesting, more pitiable than any other, and, above all, gifted amid the general decay with a few superior intellects which could appreciate and describe the evils which they never attempted to cure. If we may judge from plays and novels, fainting is much less common in the nineteenth than in the eighteenth century. Men in general probably live a more domestic, healthful, and sober life than a hundred years ago; women are probably less nervous and bear and rear larger families; while children, both rich and poor, are certainly better clothed, better fed, and grow up into taller, stronger, and healthier men and women.

Brain Workers

injure themselves inmeasurably by over-eating. We recall to mind several active brain workers who suddenly broke down, and fancied that it was due to brain fatigue, when as a matter of fact, it was due to overstuffing of their stomachs. The furnace connected with mental machinery became clogged up with ashes and carbon in various shapes and forms, and as a result disease came, and before the cases were fully appreciated, a demoralised condition of the nervous system was manifested, and they laid the flattering unction to their souls that they had indulged in mental overwork. Hard work, mental or physical, rarely ever kills. If a mild amount of physical exercise be taken, and a judicious amount of food be furnished, the system kept open in a proper manner, the surface protected with proper clothing, and the individual cultivates a philosophical nature and absolutely resolves to permit nothing to annoy or fret him, the chances are that they can do an almost unlimited amount of work for an indefinite length of time, bearing in mind always that when weariness comes, he must rest, and not take stimulants and work upon false capital. The tired, worn-out slave should not be scourged to additional labour. Under such stimulus, the slave may do the task, but he soon becomes crippled and unfit for work. The secret of successful work lies in the direction of selecting good, nutritious, digestible food, taken in proper quantities, the adopting of regular methods of work, the rule of resting when pronounced fatigue presents itself, determining absolutely not to permit friction, worry, or fretting to enter into his life, and the cultivation of the Christian graces, charity, patience, and philosophy.

Can the Telephone Communicate Disease?

This question has recently been exercising the minds of the postal authorities in the Pomeranian city of Danzig, who ordered a scientific investigation of the subject. The results of the inquiry have now been officially made public, and they are, on the whole, of a reassuring nature. The exhaled air which comes in contact with the instrument every time it is used is proved to be germ-free. Should, therefore, any particles, which may be on the telephone plate, be communicated to persons using the telephone, this cannot occur through the simple breathing of air, but only under certain conditions; namely, if particles ejected by diseased, especially consumptive, persons alight by chance on the microphone and there dry in. But even this contingency is easily obviated, if the settlement of dust in the apparatus be prevented by frequent wiping with a damp cloth. The risk of taking disease by infection through the use of the telephone must then be regarded as very slight, especially as we have it on scientific authority, that it has never actually been established that where a person who was in the habit of using the instrument had contracted a contagious disease, this was communicated by the medium of the telephone.

The Speed of the Pulse

depends entirely on the movements of the heart, each beat representing a contraction of the left ventricle. The normal pulse of the adult male varies from 60 to 80 beats in the minute; the range of individual variation is, however, very great. The range in females is even greater, some having a pulse rate of over 80, others less than 60, the majority showing a higher rate than males. In children the rate is more frequent: At birth, 128 to 144; first year, 120 to 130; at 16 years, 90. In old age the pulse is usually above 72, but often also between 50 and 60. The pulse rate is higher in short than tall persons, and also varies somewhat with the time of day, independent of meals and movement—diminishing in the forenoon, rising in the afternoon, sinking during the night and rising in the morning. Habitual pulse rates below 56 and as low as 46 have been observed in healthy adults, but they are rare exceptions. We know of no case on record of a healthy pulse so low as 30.

Cobwebs

are frequently used to arrest the bleeding of wounds. When Bottom was "translated" and introduced to the attendants of Titania, he endeavoured to ingratiate himself with Good Master Cobweb by saying, "When I cut my finger I will make bold with you." Experience has shown that the gossamer of which the web is composed forms a very useful styptic; but the *Lancet* points out a very fatal objection to its use which arises from the fact that as an application to an open wound it can never be guaranteed to be surgically clean, forming as it does a net for insects, and at the same time for the germs of many an infectious disease. Evidence of this was produced before the Liverpool coroner recently touching the death of Martha Roberts, who, following the time-honoured custom, had applied a cobweb to her wounded hand to stop the bleeding. Blood poisoning followed upon its application, and this terminated, unhappily, in a fatal issue. It is not a solitary case. The principles of aseptieism have not yet become part of the intellectual equipment of the people, neither have its lessons succeeded in overcoming prejudice. We counsel no more cobwebs, but an application of cold water under the tap.

The Growth of Plants at Night

appears to have puzzled a correspondent, who wishes to know whether they really increase in size from sundown to sunrise, We may say that while many plants close their petals or fold their leaves as darkness approaches, the testimony of most scientists is to the effect that none cease to grow. A series of experiments has recently been made with quick-growing plants, such as asparagus, lettuce, radishes, and the like, with a view of ascertaining whether the growth continues at night with as great a rapidity as during the day. The result has determined that, while the growth is continual, with most plants it is by no means so rapid during the dark hours as during the light. There are, however, many exceptions to this, not a few plants being nocturnal and growing more and faster during the night than in the day time. These, however, are usually tropical, and their habitat is commonly in dense forests, where even during the day time no great amount of light is able to penetrate.

The Virtue of Boiled Water

is descanted on by a correspondent who writes:—"We hear of the typical Scotchman who never sees the point of a joke until about a year after it has been uttered. I was a young fellow visiting in the country, and stopped, at a paper mill out of sheer curiosity. They had just put in an engine to supplement the water wheel in the summer and in other dry spells; and the proprietor told me with a chuckle how much better they were doing then, since they had commenced to boil their water. It was three years after that that I saw the point. When I did see it I saw that the old paper maker, with his little mill and his old-fashioned way of doing things, had uttered a truth that was primal and philosophical. As he had been using water as a motive power, it was acting only by virtue of the force put into it by gravity. The greater the head or fall the greater the power. No more could be got out of it than it was entitled to by reason of the height of the dam above the tail race. Taking a very slight quantity of that water and boiling it, it could then be used to develop force with a strength due to the virtue put into it by the heat of the fire. In both instances, the water was merely the medium through which one of the forces of Nature could act upon machinery. In the first case that force was gravity; the attraction of the earth as a mass for the water. In the other case it was heat; the energy developed by the attraction of particles of oxygen in the air for particles of carbon or hydrogen in the fuel."

Three Years Too Late

the joke of the old paper maker came to my mind, he continues. It has never since left it, although that was a good while ago. I have since thought how it may be extended; how the simile might be completed. The turbine wheel, using the water acted upon by gravity in a simple way, corresponds to the non-condensing steam engine using the water acted upon by heat. In the case of the turbine the work done is measured by the difference of the water's velocity when it entered and when it was discharged. In the case of the engine, the work done is measured by the difference in the temperature of the steam when entering the cylinder and when leaving it in the exhaust. If we attach to the turbine a draught-tube, we avail ourselves of more of the force that is in the water than if we did not. If we add a condenser to the steam-engine, we do the same thing by increasing the difference between the initial and the final temperatures. In both cases we must not forget that the force does not lie in the water, but in what acts upon it.

Hypnotism by a Snake

is thus described by a correspondent: "The water was perfectly clear, and not above two feet deep; the day calm and bright, and the proceedings below the surface were easily observed. In the deepest part of the pool a solid phalanx of little fish (if I may so call it) was swimming around and around in a ring of about two feet in diameter, the band being about six inches wide, and, apparently, two or three layers deep. Around and around they went, at the least motion on our part breaking ranks, to resume their circus at once when we were quiet again. We were interested, of course, and puzzled, and we tried for half an hour or more to learn the cause of such unusual movements. Our talk, for we did talk, did not disturb them, from which we inferred that they could not hear us; our slightest movement did, from which we inferred they could see us. Carefully crawling a little nearer, we discovered the centre of the moving circle was a large water snake, coiled, quiet, and watchful. Ornithologists have told us in unreliable school books that snakes can and often do charms birds, and some have, in their more elaborate works, tried to substantiate that theory. I never believed it, and I certainly never heard of snakes charming fish—but what were those shad doing? Were they charmed? If they were afraid of his snakeship, why didn't they run away, as they did when we stirred? Why, when our disturbance ceased, did they persistently return and take up their ceaseless round in so dangerous a neighbourhood? These are conundrums that I can't answer. Can you?"

The Smoke Nuisance

has of late, evoked a variety of ingenious suggestions for its cure. There is a party, however, what may be termed the "anti-smoke curers," who claim that the presence of soot may act as a germicide, and therefore, in a sanitary sense, may be beneficial. This suggestion is, Dr. Thomas Bond writes to say, the greatest rubbish. The truth is, he tells us, that hundreds of lives are lost annually from bronchitis and other chest diseases as the result of breathing this irritating compound. Again, thousands of pounds are lost yearly through interruption of business caused by the black pall which often enshrouds London for days, and this great capital, which ought to be one of the finest cities in the world, has become a by-word of reproach and a place to be avoided during certain seasons. Again, our finest public buildings and statues become dirty and begrimed, and the whole city shows the impress of its murky atmosphere. He therefore hopes that the bill which has recently passed its second reading in the House of Lords will become law. It proposes no drastic or impracticable measures. It simply confers powers on the vestries to frame regulations for the abolition as far as possible of this black scourge. He is quite aware that in the present state of our knowledge no definite plan of action can be laid down, but when it becomes illegal to poison the atmosphere with smoke Dr. Bond believes that before the dawn of the next century, now rapidly approaching, scientific research and practical experiment will do much to mitigate this scourge.

Mr. Edison's Communications

to Mr. Poultney Bigelow, which have appeared in the *Speaker*, are somewhat bellicose. Mr. Edison believes in his new flying machine, which, he assures us, can be projected into space at any given angle with the aid of an electric motor and revolving fans for about 50 miles, dropping dynamite by the way on the heads of the enemy. About a quarter of a ton of this explosive is the quantity that Mr. Edison thinks he can conveniently drop anywhere he pleases. The machines are described as cheap and portable. Unlike war balloons, there would be no profit in firing at them, for in falling they would destroy those below. They can, moreover, be stealthily made, for while every machinist in the country might be employed upon parts, they could be fitted together in the military depots. Mr. Edison's workshops and laboratories are just 13 miles from New York, and from this point he could, he declares, engage, if necessary, to rain dynamite all over that city with impunity. "The material," said this terribly ingenious person, "is at hand, and I could place contracts with thousands of machine shops that could within a few days turn out all that would be required."

GLEANINGS OF THE GLOBE.

THE camel was probably the first animal trained for riding.

THERE has been very little ice sighted by the Atlantic liners this season. The absence of the ice, it is hoped, signifies a fine, warm summer to come.

A TECHNICAL paper gives this advice to those who have to handle dangerous electrical conductors or apparatus, in order to insure their personal safety :—"Keep one hand in the pocket, in order to make sure not to use it."

A CANADIAN electrician claims that electricity causes the tides, and demonstrates it by electrifying a rubber comb by rubbing it through the hair, and then drawing it over the top of a glass filled with water, the result being that a tidal wave follows the comb.

THE following recipe is recommended by the *Lancet* as a cure for colds in the head :—Trinitrate of bismuth, 6 drachms ; pulverised gum arabic, 2 drachms ; and hydrochlorate of morphia, 2 grains. The preparation is used as a snuff, and cures in a few hours.

FIRST aid to the injured is forming the subject of a course of lessons for women, given by Mr. S. Osborn, F.R.C.S., under the auspices of the St. John Ambulance Association, at the Morely Memorial College, Royal Victoria Hall, Waterloo-road. The lectures take place on Friday evenings. The entrance fee is very moderate.

IT is a strange fact, Dr. Richard Neale tells us, that such diseases as typhoid and dihptheria are very little known in in those countries where an open system of drainage is employed. It is inexplicable that our excellent hygienic arrangements should leave us exposed to dangers from which other less fortunate countries are exempt.

SINCE it has been ascertained with a good degree of certainty that the earth's axis is unstable, to a certain extent, all scientific calculations based upon the assumption that the axis is permanent are misleading. This, it is claimed, accounts for the miscalculations of astronomers during the past 200 years.

MANY people suppose that rosewood takes its name from its colour, but this is a mistake. Rosewood is not red or yellow, but almost black. Its name comes from the fact that when first cut it exhales a purfume similar to that of the rose, and although the dried rosewood of commerce retains no trace of this early purfume, the name lingers as a relic of the early history of the wood.

A MEDICAL contemporary expresses a cordial dislike for the trailing gown that is now the fashion with ladies, both on account of its close and clinging unwholesomeness as regards the wearer and on the ground of its public inconvenience. Nevertheless, the surest remedy for infection by means of dust is rather to be sought in the cleansing of thoroughfares than in the restraint of fashions in dress.

SPEAKING recently on the question of the habitability of Mars, Mr. Gregory, F.R.A.S., said that, while the conditions on the planet are very different from those prevailing on the earth, the difference is less than in the case of any other heavenly body with which we are acquainted ; and if life, such as life is known upon the earth, can exist anywhere else, Mars is the place. But there is at present no scientific ground for belief one way or the other.

A FRENCH experimenter has tested the strength of 50 robust men and 50 healthy women, all of the middle class of society and between 25 and 45 years of age. The strongest man was able to give with the right hand a pressure equivalent to 187 pounds, and to the weakest one of 88 pounds. The short men were nearly as strong as the tall, the average difference being less than seven pounds. The force exerted by the strongest woman was only 97 pounds, and that by the weakest was but 35 pounds, while the average was 72 pounds.

MR. H. LE CHATELIER has made a communication to the Paris Academy to the effect that the "effective" temperature of the sun is 7,600°. The term effective temperature is used to express that temperature which a body having an emissive power equal to unity should possess, in order to send out radiations of the same intensity as the sun. The real temperature of the photosphere is higher than 7,600°, because its radiations are absorbed by the cooler solar atmosphere, and it may be, also, because the emissive power of the sun is less than unity.

As waves radiate when a stone is dropped into still water, so sound travels by waves radiating from a central point of disturbance. So far as the hearing of each individual is concerned, these waves move in a direct line from the cause of the sound to his ear, the impact being the greatest in the ear nearest to the source. This being the case, a person who has totally lost the sense of hearing in one ear, although he may imagine the defect is of little consequence, cannot locate the direction of a sound to save his life, even when the centre of disturbance is quite near him.

WE have had submitted to us a sample of the improved eclipse photographic changing bag, designed for changing sensitive plates in open daylight. The rubber bag, in its improved form, contains two sleeves in the upper corners, and three bags on the inside lining. The sensitive plates are stored in these bags, and by inserting the dark slide and the hands through the sleeves, the sensitive plates already in the slides may be changed for a fresh supply with perfect safety. Mr. F. Beresford, of 14, Bridge-road West, Battersea, is the maker of this useful arrangement, which should prove of great service to all outdoor photographers.

THE following is the May programme of the Tuesday evening "Penny Science Lectures," given at the Royal Victoria Hall, Waterloo-bridge-road :—May 3, C. Vernon Boys, Esq., "Flying Bullets," illustrated with lantern-photographs taken at full speed. May 10, William Hancock, Esq., F.L.S., F.R.G.S., (Of the Chinese Imperial Customs Service), "Travels in Java and Sumatra," illustrated with dissolving views. May 17, William Carruthers, Esq., F.R.S. (of the British Museum), "The Wonders of the Rocky Mountains," illustrated with dissolving views. May 24, Bennett H. Brough, Esq., Assoc.R.S.M., F.G.S., "Mines and Mining," Chairman, W. Bowden Rowland, Esq., M.P., with lantern illustrations. May 31st, C. T. Dent, Esq. (late President of the Alpine Club), "The Alps in Winter," illustrated with dissolving views from original photographs.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 27.

85.—How long is it supposed that the earth's supply of coal will last?

There is a great diversity of opinion on this subject. It if safe, however, to assert that the supply is good for several thousand years. The British islands possess 146,457 millions of tons of coal available, besides 48,465 millions unavailable under present methods of working. Deposits of similar, although not of equal, extent exist in continental countries; but they are far surpassed, as is well-known, by those of the United States. It is needless to add that many great deposits of coal are buried in other quarters of the globe, and of these other coal beds—while some few are worked—the great proportion now lie practically untouched. I may instance a virgin field of coal in China, an area of 30,000 square miles, in which the coal seams, 30 feet thick, are perfectly horizontal for 200 miles. The total annual consumption of coal throughout the world is now about 300 million tons, and the enormous output of the British islands approaches to half of this. While it seems probable that the coal measures of the British islands may be exhausted within a few generations only of the present time, we must expect that this event will only serve to divert trade into fresh channels, and that the average price of coal throughout the world will scarcely be affected. Indeed, as science introduces new economies in the use of fuel, and as improvements are affected in the art of mining coal, we cannot but suppose that for, perhaps, many hundreds of years to come, the average price of coal will rather tend downwards than otherwise. Nothwithstanding the constantly increasing use of artificial power and the rapid multiplication of the human race, it may be that the world's annual consumption of fuel will actually decrease.

86.—How is the speed of rotation of the sun determined?

The *simplest* method of determining the period of rotation is to observe the average rate of motion of the sun spots across the sun's "disc." The most interesting is based, however, on an effect of continuous motion when compounded with the oscillations of a light-producing molecule. If an exceedingly small beam of light be considered, the motion of the ether in it is like the motion of water waves upon the surface of the sea. When the length and the period of the waves is, comparatively speaking, long, we have red light, when short, violet, and of all possible intermediate lengths each corresponds to a very minute difference from the next faster and the next slower wave, in what we describe as colour. The human eye is incapable of appreciating any but strongly marked differences of tint. With the aid of the spectroscope, however, a very great increase of sensitiveness is obtained. The spectroscope, an instrument dependent on the "refractive" property of an oblique surface of contact between glass and air, sifts out the longer from the shorter waves of light—diverts each wave from its original direction by an angle that increases with the frequency—and thus the quality of light, instead of being roughly judged by tint, is ascertained by linear measurements, susceptible of great exactitude, upon a spectroscopic scale. Of course, when a luminous body is in continuous motion the ether waves it radiates are shortened in the direction of its motion, and drawn out in the track it leaves behind. Owing to the enormous speed with which light itself travels, such modifications of the wave length or "colour" before and behind a moving radiant, can only be detected when this motion is in a straight line with the observer, and is effected with celestial velocity. A speed of 36 miles per second alters the wave length of light emitted in the direction of motion by the ten millionth of a millemetre. The speed towards us or from us at the equator of the sun does not exceed 1·2 miles per second, but even the minute change of "colour," which this rate of motion impresses on the incident light, can be recognised by spectroscopic methods, and can, indeed, be very accurately measured. This measurement affords the "spectroscopic method" for the determination of speed of rotation of the sun.

87.—In what way should eggs be cooked in order that they may be most digestible?

The proper method is to plunge them in a vessel of boiling *hot*, but not boiling water. The eggs cool it immediately, and are cooked at a temperature not much exceeding 180° F. —the temperature at which albumen coagulates without hardening. Thus cooled, the albumen will be found in a flocky condition, not compacted and hardened, and very digestible.

88.—What amount of heat would be produced by the collision of two cannon balls moving in contrary directions?

Let us assume that the balls are made of lead, weighing each 50 kilogrammes, and moving at the rate of 500 metres in a second. The heat energy represented by their combined momenta is in calories $\frac{(50+50)\times(500)^2}{8340}$ or, say 3,000. This means thirty calories to every kilogramme of lead, and as the specific heat of lead is only ·0315 and its latent heat of fluidity 5·37, it follows that the heat produced by the impact of the leaden balls would be nearly double that required to melt them.

89.—What influence does the moon have on the weights of small terrestrial objects?

The mass of the moon is $\frac{1}{80}$ of that of the earth, and it is 60 times as far removed from the earth's centre of gravity as what we ordinarily understand by "terrestrial objects." The moon's attraction is therefore $\frac{\frac{1}{80}}{60\times60}$ or $\frac{1}{288000}$ of that of the earth on equal masses. If the attractive action of the moon could be suddenly annihilated, this is the accession of weight that would take place in any terrestrial object in a line joining the centres of gravity of the earth and moon. But no such accession of weight as this is felt when the moon sets below the horizon. For it must be remembered that the moon's attraction is not perceptibly affected by the interposition of the body of the earth. It is only in proportion to the difference in its distance from us—in the proportion of the square of 59 to the square of 61, that the apparent weights of small terrestrial objects are altered by the position of the moon. With the moon over our heads, apparent weight is least, and when the moon shines on the

antipodes, apparent weight with us is at its maximum. But all the difference of weight thus caused does not exceed $\frac{1}{4320000}$ of the earth's gravitation power.

90.—How fast is the solar system moving through space?

It is approaching to the constellation of Hercules at the rate of about half a million miles per day; that is to say, the sun, with its attendant satellites, moves through a space about equal to its own diameter in every two days.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

97.—Is the pole star absolutely fixed in space over the North Pole?

98.—In what way is it easiest to distinguish a boiled from an unboiled egg without breaking the shell?

99.—What is the best method of preserving botanical specimens?

100.—How large are the molecules of matter supposed to be?

101.—In what way is the total heat radiated by the sun arrived at?

102.—Do not the bones become weaker with age in human beings? If so, to what extent?

REASONS FOR BALDNESS.

There is no doubt that baldness is on the increase. It it equally certain that it has never received the attention is deserves from medical men. It is, in fact, curious to note that the treatment of baldness, like that of corns, has fallen almost entirely into unqualified hands. This may be due to our having regarded both diseases as too common, and, therefore, unworthy of our notice, yet the former condition is a great cosmetic defect, and the presence of the latter one of our most constant annoyances. It is, therefore, with great pleasure that we note the advent of a hair specialist, Mr. Otto Eduard Horn, of Newport, Isle of Wight, whose credentials are vouched by the signatures of well-known and respected English medical men, as well as that of Professor E. Pfaff, M.D., the German microscopist; while Mr. Horn himself derived his experience from the Berlin Skin Hospital.

Apart from the beauty of hair, its retention is important on hygienic grounds, since it tends to equalise the temperature of the head, shelter the brain on the one hand from cold, and on the other from the heat of the sun's rays. Trophoneurosis, or disturbing nervous influence, also plays an important part in baldness. And here we have cause and effect. If the thinning of the hair, when it commences from whatever cause, be allowed to continue unchecked, the cranial nerves become weakened from exposure, and the disappearance of the hirsute growth will then be hastened, and the consequent physical debility due to nerve weakness be encouraged. In short, the causes from which baldness may arise are very numerous—far too numerous to be set forth here—but in nearly all cases the origin is difficult to trace by the lay mind.

To those who would learn more about the reasons for baldness we strongly recommend a perusal of Mr. Horn's work, "The Human Hair: Its Treatment in Health and Disease." Prevention is better than cure, and even those who are not already afflicted may adopt many measures to insure the survival of this useful provision of nature. Those who are already troubled with baldness cannot do better than try Mr. Horn's preparations, which have borne the test of medical analysis and have been certified as free from noxious ingredients and serviceable in the direction we have indicated.

MOTIONS OF THE HEAVENLY BODIES.

It is generally thought by astronomers to-day that all the celestial phenomena within reach of human vision belong to a single great system; but it is not yet possible to say just what the controlling order in the motions of the stars composing the visible universe is. Observation shows that all the stars are in motion, but with varying velocities, and in all possible directions. In the same quarter of the sky, and even in comparatively crowded aggregations of stars, some are found to be moving in one direction and some in another. In the case of the well-known figure of the Great Dipper, for instance, the motions of the stars are such that in the course of some thousands of years that figure will cease to be remarked in the sky. Many of its stars will have separated, going in several directions, although some of them will continue to keep company, as their journey lies the same way in space. So, too, some of the stars are approaching us and some are receding from us. The spectroscope, aided by photography, enables astronomers to measure the velocity of these flying suns that are either coming nearer to us or passing further from us, with an accuracy that takes account of a single mile per second. The sun is not exempt from this universal law of motion. It is speeding at the rate of several hundred millions of miles in a year towards a point in the northern heavens situated not far from the brilliant star Vega, a sun that is vastly more luminous than our own. So we on the earth are not travelling, as most persons imagine, in a beaten track around the sun year after year, but the earth follows the sun in its northward-pointed course, and consequently sweeps onward in vast spirals around the moving sun, so that we are continually borne into new regions of space.

The extension of the law of gravitation throughout the universe has been questioned, but never very seriously, and every fresh investigation of stellar motion strengthens the belief that that law really governs the whole visible celestial system. In the case of the binary stars, of which a great number are known, the revolution of the two stars around one another or around their common centre evidently takes place in obedience to that law. Now, if gravitation extends throughout the universe, no star can escape from the attractive influence of every other star, and of all the other stars. So gravitation in itself forms, as it were, a system of links or chains binding the stellar system together. If we can ascertain the distance and the mass of any star in the heavens, it is a simple problem to determine just how much the force of that star's attraction upon our sun is. But when an attempt is made to apply this general principle to an investigation of the actual motions observed among the stars, almost insuperable difficulties are encountered. Those motions occur in so many different directions and with such various velocities, and our knowledge of the actual distances of the stars from us and from one another, and of their actual masses, is so fragmentary and incomplete, that no systematic order, betraying a grand centre, or a universal law, controlling the gyrations of the celestial bodies, becomes apparent from their examination.

More than once it has been imagined that the great centre of motion in the universe has been discovered or located. Many years ago Madler thought that the Pleiades were the centre around which our sun was moving, and the

beautiful star Alcyone became widely celebrated as the great central sun. But it was all imagination. Later investigations showed that Madler was mistaken, and now astronomers are not even prepared to say in what direction the centre of the sun's motion lies, or, indeed, whether it is not at present actually flying ahead in a straight line. So speculations on a genal rotation of the Milky Way, that vast irregular stellar ring, which girdles the visible heavens like a belt, and contains within its borders the majority of all the stars, have generally been abandoned in face of the fact that no common motion of its component stars can be detected.

Yet no astronomer doubts that there is a general law governing the maze of motion which we behold about us. The fact seems to be that there are many centres of motion, as the tendency of the stars to aggregate in streams and clusters indicates, but the precise relation of these aggregations to one another has not yet been made out.

The problem is complicated by the fact that some stars are known to be moving, apparently in straight lines, with velocity so great that the combined attraction of the whole known universe would not have sufficed to have set them going as they are. Nor can the astronomer foresee what the future career of such stars will be after they have passed out of the stellar system, as they seem destined to do. Are there invisible systems beyond our starry swarm from which they have come or to which they are returning?

Yet, however difficult it may be to account for the observed motions of the stars, it is impossible to resist the conclusion that everything that we see in the heavens forms part of a single system. The idea that some of the faint nebulous specks, glimpsed here and there, may be outer systems far beyond the confines of our own stellar universe, has been abandoned since the spectroscope has shown that the misty patches of light, which even Lord Rosse's giant telescope could not resolve into stars, are really masses of matter in a gaseous condition, and not, as was formerly supposed, congregations of stars so remote that the utmost magnification could not disentangle their mingled beams. The very variety which we behold in the universe shows so clearly the operation of systematic forces of development that it serves as an argument in favour of the view that all we see are only different parts of a single system.

Elements that exist in the earth are detected glowing in the atmospheres of stars in all quarters, but the same instrument which reveals the presence of these elements discovers also the fact that the bodies constituted of them are in various stages of development. Our sun represents only one type of a solar body, and its condition is not permanent and unchangeable. In Sirius and Vega we behold suns which are evidently glowing with a far fiercer energy and a much greater intensity of radiation than our sun exhibits at present. But we may go a step further back than that which Sirius or any star represents, and perceive in the whirling spirals of the Andromeda nebula, and in the vast streams and condensing aggregations of the Orion nebula, evidence of the formation of stellar centres out of elemental chaotic clouds through a process that is going on now, and, so to speak, under our eyes. It is indeed a living universe which includes the earth that we inhabit.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

WHAT ARE GHOSTS?

A HUMOROUS THEORY.

The man was lying at full length on a lounge in his studio, contemplating the toe of his right slipper, which just then seemed to have for him such a fascination as a ball of crystal has for almost any dreamy person when it is long and steadily looked into.

"There are sensitive people," said the man, "who can gaze into empty space and see there forms and apparitions which probably have no objective existence whatever. In saying that they probably have no objective existence I do not mean that they do not really exist, but only that, with equal opportunities and looking in the same direction, two persons never see the same apparition."

"Is visibility to two or more persons the proof of the objectivity of a material thing," we asked.

"Let us distinguish," said the man. "Some material things are by their very nature invisible, and all things are visible in the dark. Besides this, it is a fact that some things—such, for example, as the stars and the northern lights—can be seen only in the dark. The great majority of ghosts come under this category, although there are others that are visible by day. If I were a member of any of the various psychical researeh societies I should suggest, as a prime necessity of scientific research into the nature of ghosts, that they should be classified at first under two general heads. First, those that come by day, and second, those that come by night. This would do very well for a beginning, afterwards other divisions would be in order, and investigation should be entered upon to discover whether or not some species are amphibious, and come by day as well as by night. Some, and possibly a very large class, would be found to be vespertine in their habits, coming out and flitting through the dusk in search, possibly, of the stuff, whatever it may be, which affords them suitable sustenance."

"Are you not very materialistic in your tendencies? If apparitions have no objective reality, what need have they of food?"

"Your question is natural enough," said the man, "but it displays a singular lack of sagacity on your part. What reason is there for believing that subjective animated existences do not require food? Even the larvæ of ghosts need sustentation. Man needs to eat, and what is a man but the larva of a ghost? He remains in the larva state some sixty or seventy years, and then, with the assistance of his associates, is inclosed in a cocoon and becomes a pupa, after which he becomes an image, a true ghost, and occasionally comes as an apparition to sensitive people. The ancient Egyptians had a keener appreciation and a truer knowledge of this fact than we moderns have. As they were in advance of us in most things, so they were in this. They made mummies of the ghost larvæ in anticipation of coming events. Psychical persons commonly have a strong predilection for incineration in place of burial, but it should be sufficiently evident that incineration, by utterly disintegrating the larva of a ghost, prevents the final emergence of the image, which the Egyptians called the 'Ka.' You may remember that the Latins called a spectre a larva, but then the ancient Romans were not so scientific as the Egyptians, or as we moderns. Scientifically speaking, a spectre is an image and not a larva."

"Do you look upon a ghost as an insect?"

"Morphologically," said the man, "apparitions must thus be classed. The far-seeing vision of the poets has often observed them with wings, which, however, in most modern

instances have apparently been atrophied through the abominable habit of wearing clothes. Naked ghosts are now never seen at materialising seances, and at present not one ghost out of a thousand discloses wings. In the ghost stories collected of late by Mr. Stead, the gentlemanly editor of the *Pall Mall Gazette*, not one spectre discloses other means of locomotion than legs and feet. And yet these members alone will not account for the rapidity with which a ghost is known to have travelled from India to London. Such beings must have wings, and very possibly those members are never seen because of the velocity with which they vibrate. The wings of some insects in flight vibrate as often as 1,600 times in a second, and consequently they cannot be seen. It would not be surprising to verify a similar fact in the case of apparitions."

"But would not their wings become visible as soon as the ghosts ceased their flight and came to a standstill?"

"That depends," said the man. "In the case of the coleoptera, the true flying wings are concealed under their horny cases when the flight ceases, and if ghosts belong to this class of insects, as there is much reason for believing, their wings being concealed while at rest, could not, of course, be seen."

"But if they can be seen neither in motion nor at rest, how can any knowledge of their existence be obtained?"

"The pitch of the sound emitted by the rapidly vibrating wings might be detected by the ear," said the man, "and possibly by using the microphone. Having once found the pitch, the number of the vibrations in a second could be discovered through a simple mathematical process, provided, of course, that the dimensions of the wings were known. I see no way of arriving at those dimensions except instantaneous photography, and even this would fail if the vibrations of the wings per second should be more numerous than the vibrations of light. Indeed, it is very doubtful that if the motion were considerably less than this we should be able to photograph the wings. If, for instance, there were only a million of them in a second, the heat evolved by their friction against the air would be sufficient to set them on fire and consume them, unless they were composed of some such substance as asbestos, and this would be an anomaly in nature, unless there are such things as mineral insects or insects partially composed of mineral substances. And this may be so, even if it be anomalous. Outside of mathematics everything is possible, and some new calculus may before long make all things possible even in mathematics."

"At present, at all events, it is impossible to get at the dimensions of ghosts' wings?"

"I think so," said the man, "but, of course, there is no telling. Science advances. Mr. Edison is going into the metaphysics of spirits, and someone else is going into their physics, and what may we not hope for in the line of invention and discovery? Even I, with my restricted acquaintance with physics and metaphysics, and even of the universe itself, can imagine a way in which the matter of which ghosts, or at least the wings of ghosts are constructed, might be determined, though I doubt that their dimensions could be arrived at. If they move with sufficient velocity to be set on fire, I would apply the spectroscope to them in their incandescent state, observe the lines of the spectrum thus produced, and thence determine the nature of the burning substance. It is in this way that we determine the substances of which the sun and stars are made, and I have yet to learn why it would not be applicable in pneumatology."

"But how would you get at your ghost? If he started, say from India, to fly to London, it is incredible that he should arrive at his destination. His wings would soon be consumed, and he would have no means of travelling to you and your spectroscope."

"I grant," said the man, "that ghosts are very elusive things. We know so little of them, except through testimony that is equally elusive, that we can hardly be said to be able even to imagine how they would proceed from one place to another without possessing some means of locomotion. But you should remember that the very fact that we know next to nothing about them warns us not to say what they cannot do. According to Mr. Stead's "More Ghost Stories," the late Lady Sandhurst, while still in the larva state, could be in two places at once, and it was, you may recollect, a serious question among the schoolmen whether spirits, when going from one place to another, passed through the intervening space. If a spectre wished to come from Bombay to my spectroscope in London without consuming his wings, he might then skip the intervening space, and be here without coming. Even fleas, which have no wings, can do something analogous to this on a small scale; on battle-fields vultures have been seen to come from nowhere to prey upon the dead, and every cook knows that house flies do a quite similar thing when fish is frying. Even wholly inanimate things—lightning for instance—can travel so rapidly as practically to be in dozens of places at the same time, and the air is everywhere at once without going anywhere except under peculiar conditions. Nay, even purely imaginary things may possess the faculty; the equator runs all around the world, yet never moves relatively to the earth's axis or the degrees of longitude or latitude. Is there any reason for supposing that what can be done by animate, by inanimate, and by imaginary things cannot be done by purely subjective existences, such as ghosts, who are, in reality, simply non-objective insects? They may be this, at least; they are as likely to be that as anything else, and, until more is known about them, it cannot be shown that they are anything else. And when something may as well be anything as anything else, it becomes very difficult to say precisely what it is."

"Evidently there is one thing on which you pride yourself. You must be nice and precise or else you are nothing. But if a ghost be an insect, it ought to have six feet, six legs."

"When it is in the cocoon state, before becoming an image, it is pretty apt to get 6 feet under ground," said the man. "If you imagine that I am making puns merely, you should remember that puns are as possible in thought and theories and statements of fact as they are in words. When thoughts and things resemble each other sufficiently, the one may be substituted for the other, and in commonplace thinking, such as the most cultivated man shares to a wonderful degree with savages, among whom 'animism' appears everywhere, there is always—and necessarily—suspicion that a notion is taken as a fact. Now, my notion is that ghosts are insects, and it may be that the notion may precisely represent the fact, in which case it would not be even an approach to mental, let alone verbal, punning. All other attempts to explain them have proved futile, and if the world does not accept mine the world will be like a ship at sea without rudder, keel, or compass, and it will stay so till a real ghost shall be caught in some scoop net or other ingenious contrivance, and dissected just as the ghost larva, or man, may now be. Did you ever hear of a desiccated ghost or ghostikin? Are not spectres always examined on the supposition that they have no real and substantial being, and are therefore entitled to more respect than would be shown them if they could be caught, have pins run through them and put in glass cases? I refuse to think seriously about

them till this, or something like this, shall have been done. They are nice things to talk about and to engage the vagrous mind, but there are lots of such things. Leave me now, and let me go back to my landscapes."

He was left, and his theories will probably be left also.

ASTRONOMY GRAPHICALLY PORTRAYED.

Educational amusement appears to be more largely catered for in Germany than in this country. A Berlin showman has inaugurated a series of astronomical lectures on an entirely novel plan. The spectators see a realistic display of lunar and solar eclipses from the standpoint of observers on the earth, then on the moon, and again from space. The first scene shown to the spectators is one of the most interesting of the whole evening. It represents a landscape near Berlin, with a lake in the background. It is darkened at first, and then the clouds in the sky begin to take on a rosy hue. It is a very good simulation of an approaching sunrise. The sun appears above the horizon as a blood-red crescent. It is being eclipsed, and as it ascends less and less of the crescent is seen, until the sun is totally eclipsed. It appears then simply as a black disc with the corona about it. The landscape is involved in the curious darkness which results from an eclipse. The sun's reappearance is faithfully depicted, until it becomes a full round ball of pure white light, a very good counterpart of the original.

In the next scene the spectators are viewing the same solar eclipse from a point in space supposed to be 80,000 miles away. They see the earth hanging in space, a large globe, with stars shining about it. The rays of the sun coming from the right illuminate half of its surface. The moon is seen to come into the sun's rays and its shadow falls upon the earth and advances across its surface. The phenomenon of a solar eclipse is thus graphically explained.

The next scene depicts an eclipse of the moon in space, and in the fourth scene the spectators are looking from a distance of 4,800 miles at the moon suspended in space. From behind the scenes the sun's rays fall upon the moon, and the shortening shadows of the mountains on the moon indicate sunrise.

In the next act, for the representation is divided into acts, the observers are supposed to be actually on different portions of the moon's surface, looking on its mountains and craters. The barrenness of the moon's surface is sharply defined in the sunlight striking across it

In another scene the earth is seen hanging over the moon and casting its reflected light upon it. The sun rises on the horizon of the landscape, and is eclipsed by the earth itself, the strange red glow cast upon the moon's surface being very well reproduced. The last act has scenes upon the earth again, one a lunar landscape in the highlands and another a sunset in the Indian Ocean.

In a recent lecture on "Electric and Magnetic Screening," Sir William Thomson condemned the use of the single-wire system of lighting ships by electricity, on the ground that observation has shown it to produce an error in the ship's compass of three to seven degrees, every care being taken. It has been argued that the iron hull protects or screens the compass from the deflecting influence of the current, but Sir William declared that this argument was fallacious. He, therefore, recommends the double-wire system for electric lighting on board ship; that is to say, the use of a going and returning wire, except in the unusual case of an alternating current being used.

MODIFICATION OF OUR CLIMATE.

Every now and then some weather sage predicts extremely cold winters, and another ventures to say that the sun is gradually losing heat and in time arctic cold will prevail over the globe. Whatever may have been the changes during the vast cycles of time prior to the advent of man, or whatever may be the changes in the time to come, one thing is quite certain, that our climate has been much modified within the past two or three thousand years.

"There have been fifteen climatic changes since the beginning of the glacial age, each change lasting 10,500 years, and each change reversing the season in the two hemispheres, the pole which had enjoyed continuous summer being doomed to undergo perpetual winter for 10,500 years, and then passing to its former state for an equal term. The physical changes upon the earth's surface during the past 80,000 years modified the changes of climate even in the arctic regions, so that the intense cold of the former epochs was much modified during the latter epochs."

Reckoning these climatic changes in their order, we had entered the epoch of a more genial temperature about fifteen hundred years ago; and if no disturbing change takes place during the present epoch, we may reasonably expect a gradual modification of our winters for nine thousand years to come. The changes to intense cold from perpetual summer during the greater part of the glacial period are supposed to have been caused by the high temperature of the north pole as compared to that of the south pole, owing to the distribution of land around the two, the south having almost none. Professor Croll thinks it was caused by the varying inclination of the earth's axis, which produced the relative position of the two poles toward the sun to be periodically reversed at distant periods. Professor Geikie agrees with Croll on the reverse of seasons every 10,500 years during certain periods of high ellipticity of the earth's orbit.

But, asks a correspondent, Mr. Joseph Wallace, "How could the fauna and flora propagate themselves under such conditions?" The flora itself at the quarternary age was of extreme vigour. We know this from the little which is left us, but more especially from the presence of a large number of herbivorous animals—stags, horses, elephants, rhinoceros, etc.—which animated the plains and valleys of Europe and America at the same time. Evidently they could not have lived and propagated themselves without abundant vegetation for nourishment and development.

That which has deceived the adherents of the glacial theory, as understood in its absolute sense, is, they have generally placed a too high estimate on its extent and intensity. It needs but a little effort of the reasoning powers to come to the conclusion that the earth had cooled to the degree that all animal and vegetable life could exist upon it, and that upon a portion of the earth's surface permanently covered with snow and ice was absolutely indispensable to the existence, perpetuity, and well-being of animal and vegetable life. Again, they have attributed to the glaciers the rocks, gravels, and other material which they have found spread here and there long distances from the mountains. The transportation of the so-called erratic rocks has appeared inexplicable in any other way, and the piles of rock and gravel have been considered so many *moraines*, that is, deposits of diverse material transported by the glaciers. They do not regard the probability of other agents taking the place of glaciers, and undervalue the moving power of water. Water in liquid state has often produced analogous effects, and it has often been the error of

the glacialists to confound the one with the other The erratic rocks and the moraines are undoubtedly the ordinary indications of the ancient gravels, but, taken isolatedly, they are not sufficient proof. In order to convince they should be accompanied with a third indication, which is the presence of striated rocks which we find in the neighbourhood of our actual glaciers. When all these signs are together then there is hardly a possibility of error, but one alone is not sufficient, because it can be the effect of another cause.

No doubt the temperature was really lower at the quarternary age and at the epoch generally assigned to man's advent in European countries, but the difference was not so great as some say. A lowering of four degrees is sufficient to explain the ancient extension of the glaciers. We can look on this figure as the maximum, for it is proved to-day that humanity played the main *role* in the glacial phenomena. The beds of rivers and the alluvia are there to tell that all the water was not in a solid state at that time, that the glaciers were much more extended than in our days, and that the courses of the rivers were infinitely more abundant. When this is understood we can reasonably reduce the extension of the ancient glaciers, the lowering of the temperature at the quarternary age, and account for the uninterrupted life of the fauna and flora. However, we must not fall into the opposite excess and assert, as some have done, that the glacial period is comparatively recent, the traces of which are too plain and fresh in some localities to assign to it an age prior to man, and that the temperature has rather lowered itself since this epoch. The ancient extension of the glaciers has been followed by a corresponding growth and extension of animal life, thus proving that the permanence of glaciers is a wise provision and absolutely essential to man and the high orders of animals and vegetation. The ancient extension does not prove alone that it was much colder than in historic times, for the animals themselves are proof of this. At that time the plains of Europe, and of France in particular, were animated by herds of reindeer, gluttons, camels, and marmots, which one does not find to-day except in the higher latitudes or more considerable heights. The mammoth and rhinoceros are no exception to this, for naturalists know they were organised to live in cold countries.

Space will not permit us to pursue this point further, or speculate on the probable climatic conditions of the ice age ; but we can carry ourselves back a few thousand years and describe the climate of Europe and neighbouring countries of Africa and Asia. Herodotus describes the climate of Scythia in terms which would indicate in our day the countries of Lapland and Greenland. He shows us the country completely frozen during eight months of the year ; the Black Sea frozen up so that it bore the heaviest loads ; the region of the Danube buried under snow for eight months, and watered in summer by the abundant rains which gave to the river its violent course. The historian adds that the ass cannot live in Scythia on account of the extreme cold which reigns there. The following century Aristotle makes the same remarks concerning Gaul. His contemporary, Theophrastes, tell us that the olive tree did not succeed in Greece more than five hundred furlongs from the sea. We can assure ourselves that both the ass and the olive thrive in these countries at the present day.

Three centuries later, Cæsar speaks frequently and emphatically of the rigour of winters and early setting in of cold in France, the abundance of snow and rain, and the number of lakes and marshes which became every moment serious obstacles to the army. He says he is careful not to undertake any expedition except in summer. Cicero, Varro, Possidonius, and Strabo insist equally on the rigour of the climate of Gaul, which allows neither the culture of the vine nor the olive. Diodorus, of Sicily, confirms this information :—"The cold of the winters in Gaul is such that almost all the rivers freeze up and form natural bridges, over which numerous armies pass quite safely with teams and baggages; in order to hinder the passengers to slip out upon the ice and to render the marching more secure, they spread straw thereon."

Virgil and Ovid insist on the severity of cold in the regions of the Danube. The first describes the inhabitants of these miserable countries withdrawing themselves into caves dressed with the skins of wild beasts. Ovid, who had passed several years of his life in that region, is more precise in his description. He say the wine has changed itself here (Black Sea) into a solid frozen mass, one gives it to drink by pieces. Fearing of being accused of poetic exaggeration he appeals to the testimony of two ancient governors of Moesia, who could establish the facts like himself. The author who would give such accounts of the Black Sea in our days would risk his reputation for veracity.

Italy, too, experienced its part of the cold in early days. Virgil tell us of the snows being heaped up, rivers which carried ice along, the sad winter which split the stone and bound up the course of large streams, and all this in the warmest part of the Italy, at the base of the walls of Taranto. Heratius affirms that the Soracte, a neighbouring mountain of Rome, was whitened with thick snow, rivers frozen, and the country covered with snow. To-day the snow stays very little upon the Soracte and never in the country around Rome. During the four or five centuries which followed, writers speak of the severity of climate in Northern Italy, the lagoons on the Adriatic being frozen over. Algiers was much colder then than now. The Danube, Rhine, and other rivers in Europe, the Nile in Africa, the Amazon in South America, the Mississippi and Missouri in North America, had quite different volumes two thousand years ago than their present actual ones, and they especially rolled much greater masses of water.

There is everything to show a modification of climate in our own days. If this goes on in the future as in the past, there will be a marked difference in the temperature two or three hundred years from now. Even a degree in a thousand years would effect a great change in the course of time. The lowering of four degrees established the ancient extension of glaciers, though it did not interrupt animal or vegetable life. Fifty-four of the fifty-seven species of *Mollusca* have outlived the glacial age, and all our savage animals—even a certain number which have disappeared—date equally from the quarternary, and were contemporary with the great extension of the glaciers.

A BRIGHT little boy in one of our country schools wrote an essay on "Our Breath," and this is what he produced on the vital topic : "Our breath is made of air. If it were not for our breath we should die. The breath keeps going through our liver, our lights and our lungs. Boys shut up in a room all day should not breathe; they should wait until they get out doors. Air in a room has carbonocide in it, and carbonocide is poisoner than mad dogs. Once some men were shut up in a black hole in India, a carbonocide got into that hole, and afore morning nearly every one of them was dead. Girls wear corsets which squeeze their diagrams too much. Girls cannot run and holler like boys because their diagrams are squeezed. If I was a girl I would just run and holler so my diagram would grow. That's all on breath."

THE RESTORATION OF RAMESES.

Eight hundred miles up the Nile there is some restoration going on that the strictest member of the "Anti-Scrape Society" would assuredly bless and approve. Alarming news had come of the condition of the larger temple at Aboo Simbel, and modern engineering has had to come to the rescue of the great Pharaoh. A most interesting account of the operations has been sent by a correspondent to the *Pall Mall Gazette*.

Rather more than three thousand years ago Rameses II. took in hand a mountain in Nubia, and hewed out of the living rock two vast temples. One is never surprised at anything Rameses did. He pervades the entire Nile, and dominates everything, right away from Cairo up to Wady Halfa. Take all the thirty-four dynasties, and, practically, Rameses is first, and the rest nowhere. If you come across anything colossal in the way of building, anything overwhelming in design and successful in execution, you may be quite safe in putting it down to Rameses. He reigned over sixty years, begat 170 children, and lived to be nearly one hundred years old. And now he lies in his case at the Gizeh Museum, the haughty old face frowning beneath its glass cover. Short work would he have made of the hundreds of tourists who pry and peep and giggle at his Royal features. But of all the great things he did these temples at Aboo Simbel are the greatest. The larger of the two he dedicated to the god of gods, Amen, and secondarily to his own glory; and the smaller to the goddess Hathor and to his wife Nefertari. It is rare to find either in tomb or temple the record of conjugal love, but this smaller temple makes it clear that Rameses had a tender side of him. Half a foot deep on the front of the temple he cut an inscription setting forth that he, "Rameses the Strong in Truth made this divine abode for his Royal wife Nefertari, whom he loves;" and the Queen herself, tenderly responsive, carves in undying words that she, "his Royal wife, who loves him, built for him this abode in the mountain of pure waters." The better to study these temples, and to see the engineering work in progress, I slept two nights in the sand in this veritable house of love. The last thing I saw at night by the clear Egyptian starlight, and the first thing in the flush of rosy dawn, was Rameses and Nefertari side by side, looming down upon me from wall and pillar, dim, vast, and solemn.

But at the larger temple practical work is in hand. Here the four gigantic Colossi sit hands on knees and gaze across the desert sands. Three thousand years have told upon the cliffs above the temple. The statues themselves would have defied Time, but the native rock has yielded to sun and sand. In the rock itself there is a treacherous vein of clay, and the sand has at last eaten away the clay, and the fissures have gradually widened. A report was furnished to the Irrigation Department at Cairo setting forth that the great temple was in imminent peril, and that a block of stone weighing 270 tons was likely to fall and smash the only one complete statue out of the four. One of the embarrassing facts connected with the present Egyptian Administration is that nothing can be done without the consent of half a dozen Dominions and Powers. Rameses himself would have told off a thousand slaves and carted away the entire hill-top in a few weeks—he never allowed himself to be encumbered with red tape—but under existing circumstances Rameses has had to wait some months with the big block of stone impending over his head. Then the surveyor sent a still more urgent report, and ultimately Captain Johnston, R.E., and twelve English soldiers were sent up to Aboo Simbel to save Rameses. They found no less than three rocks in a dangerous condition: one measuring 34 feet by 12 was taken in hand at once and broken up into small pieces; another of 25 tons was similarly dealt with: and then the biggest of all, weighing about 270 tons, was tackled. No explosives of any kind could be used, as the two northernmost Colossi are out of their equilibrium, and the least vibration might topple them over; so five stout iron cables were placed round the big block, and then it was broken up into small pieces and thrown down into the sand. Rameses may now sit in peace and watch the dawn break over the desert for another three thousand years. The two Colossi which are out of balance are to be pinioned back to the rock behind by iron bands: the bands will be disguised as much as possible, but one regrets that a more dignified method of support for Pharaoh could not be devised. I was fortunate in seeing another wonderful thing during my visit to Aboo Simbel.

The great temple is dedicated to Amen Ra, the sun god, and on two days in the year the sun is said to rise at such a point that it sends a beam of light through both halls till it falls on the shrine itself in the very Holy of Holies. Many theories are based on the orientation of the temples, and Captain Johnston wished to find on which day in the spring of the year the phenomenon took place; so he took his instruments, and we all went up to the temple before dawn. It was the 26th February. The great hall, with its eight Osiride pillars, was wrapped in semi-darkness. Still darker were the inner hall and the shrine. Behind the altar sat the four gods Amen, Horus, Ptah, and Rameses himself, now deified. All the East was a deep rosy flush; then that paled, and a hard, white light filled the sky. Clearer and whiter it grew, till, with a sudden joyous rush, the sun swung up over the low ridge of hill, and in an instant, like an arrow from the bow of Phœbus Apollo, one level shaft of light pierced the great hall and fell in living glory straight upon the shrine itself. So twice a year does the great god visit his shrine and reconsecrate with his presence the desecrated altar. I give Captain Johnston's figures as to the exact variation:—

Magnetic bearing of axis of temple	106° 2′
Do. sunrise on 26th February	105° 35′ 30″
Altitude of sun at rising	1° 22′ 75″
Difference	0° 26′ 30″ N.

TO OUR READERS.

A Two-Guinea Portrait Free.

The Proprietors of "Science Siftings" will present a beautiful porcelain portrait, free of any charge whatsoever, to every reader of the paper who forwards three annual subscriptions of 6s. 6d. each, or six bi-annual subscriptions of 3s. 4d. each. These may be canvassed among friends, and a triple object will be served: the friends will be enlightened, "Science Siftings" will be helped onward, and a free portrait secured by the canvasser:

The liberality of this offer will be appreciated when we state that these portraits cannot be procured in the ordinary course of business under two guineas each. They are artistic portraits, beautifully finished by hand, on porcelain panels, measuring the size of this page (10 inches by 8 inches).

Another Offer.

Our object in making this offer is to cause people to talk about "Science Siftings," and thus to promote the circulation. It will be manifest that we lose money by each portrait. This, however, makes people talk about the portraits, and, hence, about the paper. We will, therefore, send to those readers who cannot induce their friends to subscribe to "Science Siftings," a portrait on receipt of 7s. 6d. to cover the cost of the porcelain panel and postage. The portrait will then be free.

Send a good portrait with the order, and the clearer this is, the better the enlarged porcelain portrait will be.

NOTE.—Owing to the large demand, we have been enabled to reduce the price of these Portraits.

SOCIAL SCIENCE.

HOW HEREDITY HINDERS AND HELPS.

Heredity is a new word in our vocabulary. There is no corresponding term in other languages. Even the German gets at the idea by circumlocution. But there is no idea born of science that more modifies our views of human nature, of society, and of social institutions. It has even become a fad of science to attribute to inheritance a very large part of conscious personality, as well as the unconscious functioning that makes up so much of us. It is, of course, difficult to draw the line and say on this side is all that I am personally responsible for; and on that side lies what has come down to me from my ancestry, and for which I do not feel that I am responsible. How curious was the complication of this fact before science invented the term heredity, or defined its application.

"In Adam's fall we sinned all." And it was but a step further for the powerful theological imagination to say that each man should hold himself guilty in Adam; and by heredity, therefore, we are not only bad, but wicked, and condemned before birth, to and for personal sinfulness. This, of course, involves the further stride that there are generations a thousand or ten thousand years ahead of us, or even ten millions of years ahead of our age—persons of vastly finer fibre and moral quality probably, from an evolution standpoint, as superior to men now existing as we are ahead of the earliest anthropoids—and yet they are doomed in Adam. It is some consolation to know that although we are fallen in Adam, we are not fallen so low as Adam was; and that the men of the far future will doubtless be still farther advanced beyond the present. Nevertheless, here was, and is, illustrated the universal fact that we cannot get into this world without bringing a good deal of our ancestors with us. Let us stop a moment to smooth over any aggrieved feeling on this point; for we are sure that many a man is cursing his heredity. Would we be better off if everyone could start out altogether *de novo*, having severed his ancestral dependence altogether? Of course, if we shirk the bad we must also yield the good. If we are not to inherit the foibles we must not expect to inherit the intellectual and moral, or the physical winnings. This we hardly any of us care to think of, for, in spite of the degenerative drift of a portion of our fellows, there has been, and is, a steady gain of the upward tendency. We cannot do better than to get the gains of a thousand generations in our blood, and "make stepping-stones of our dead selves to rise to higher things." There is also a very great argument in heredity in favour of a moral life; for who is willing that his own children shall inherit from him a drift to vileness or worthlessness?

The picture presented by heredity is something immensely startling, however, when theology lets go of it, and science gets hold of it. Not content with carrying us back to Adam, a naked savage, in a state of barren toollessness and ignorance, science goes farther back to apes; and not giving us time to get accustomed to this ancestry, pushes on stride by stride back to animals and fishes, till somewhere in the old geologic periods it points to the simple life cells, and says, "Behold your ancestry par excellence. And all the potency of all these, all the characteristics on the road of many millions of years are in you as your heredity." Not content with this, the anatomist, taking the prenatal life at different points, shows us that as we develop before birth, we actually rehearse in embryo our whole hereditary development, from earliest life up to the human; that if we could be born at a very early parental point we should not be distinguishable from the aquatic ancestry of millions of years ago.

Then, turning to us, the learned scientist says: "As soon as Nature has worked out one step in advance she packs it away into heredity, and works away at a new problem." So it will be that what we are to do, working at with the hardest dints of study, our remote successors will solve instinctively, that we are dominated by the fact that we are not wholly ourselves—that we bring into the world with us not only physical characteristics, but mental and moral biases. And the main question in education is how to grapple with inherited evil to overcome it, and with inherited good to strengthen it. It seems to be possible only by a careful study of hereditary tendency to become self-masters and self-directive.

We are all cognisant of family likenesses; and every day in chatting with our children, or with others, we are compelled to note the power of heredity in both body and mind. There is the same nervous twitch of a membrane from father to son. We know of a family where the father has three moles on his face, all of them insignificant, but all of them reappear in his children; one in one of them, and two in another, in the very locality where they are on the father But the will bias of these children, traceable back four generations, is just as marked. There is no doubt about our power to intensify the excellences of our stock, and to decrease the feebleness and errors. Strict self-discipline becomes an obligation to our descendants. Still, this rule works often by contraries; that is, children, witnessing the harm that follows certain indulgences in their parents, or in one parent, have created in themselves a detestation for the habit as well as its consequences. It not infrequently crops out in a family of children, whose father is a drunkard, that one or more falls a victim to the same indulgence, while the others revolt with extreme determination against all association with or tolerance for stimulants. Now, we cannot say that it is a case of simple heredity on either side. Indeed, almost all our inheritance is complex. A drunkard is, as a rule, a case of broken-down moral purpose or of regulative will. Either he has a lack of any noble purpose, or he has a volatile will that fails to carry out what he sees to be desirable, and what he sincerely desires.

The feebleness which the children inherit is a general feebleness; and it may take the form of mere negative stubborness as to the drinking habit, and feebleness in some other direction, as, for instance, licentiousness. The true cure for an evil habit is not to fight the habit, but to create a noble ideal and cultivate a general moral determination. That which is lacking is, as a rule, a vision of the beautiful, a purpose to live the life beautiful. There is little choice in sensuousness, whether it be in venality, gluttony, drunkenness, or aught else. The mother who drowns her clear brain, and frets her nerves with tea, may just as surely be breaking down the moral force of her children, as the father who wallows in the gutter from alcohol. The cure, therefore, for all degenerative habits is in regenerative habits. Regeneration means all building efforts, all high-aiming, all good desires. What is to be dreaded, on the contrary, is not altogether a bad habit, but a lack of moral aiming, a feebleness in desire or willing. When this is established the heredity of the child or children may take almost any evil shape. One may become a drunkard by heredity, although the parents were not fond of drink. Other corruptions may spring up in the same way. The trouble lies in a feeble moral aim.

The recurrence of the inventions of antiquity in our days,

or from time to time in human history, shows that there is also a certain store of common or race heredity which overtops our individual inheritance. Telescopes were used in Babylon over 3,000 years ago. The Egyptians had a square and compass. The Roman women used safety pins, and thimbles were invented two or three times over by different nations a thousand years apart. Printing, but without movable type, was known by the Chinese long before our era; and gunpowder they used for centuries as a plaything before Christians devised it to kill each other. Certain aims and propulsions have become fixed, as human or universal, among all races; others have become established as racial characteristics, as other sub-traits are individual or family affairs. There is a Chinese nose; there is also a Bourbon nose. There is an Aryan eye, as there is a Turanian or Mongol eye. There is a high cheek bone here, and a long head there. These things appear generation after generation. The Mongol dislikes the smell of the Aryan, and the Aryan detests the smell of the negro. The nose is the most animal of our sense organs. It is closest in affinity with the lower creatures. It has, least of all, been capable of being intellectualised. What it says it has said for hundreds of generations. It is difficult for us to argue the nose down in an assertion. Our heredity is established through one sense or another for the most part. It is sensualism, for better or worse. The way a race sees or hears gets fixed.

This study of national and racial heredities is very interesting. By what process came it about that an Aryan race was created unique, and in many ways seeing and feeling unlike those from whom it branched? But through all these wide and very stoutly established diversities our general humanity asserts itself. Unlike as we may be, we are still alike, and we do not, in the wider sense of the word, fail to recognise the celestial as our brother. The whole burden of recent history has been an effort to overcome our narrow heredity in the way of tastes, of prejudices, of biases in favour of a wider philanthropy. We begin with toleration; we end by seeing what we despised was often better than our own characteristics.

It is, however, not well for us to dwell so largely on our heredity as to dull the sense of responsibility. Unconsciously we are liable to lay our guilt on our fathers. While some try to feel guilty for Adam's sin, others make Adam alone responsible. However we tangle ourselves unavailingly in the effort to separate free will from necessity, our own freedom from the compulsion of circumstances, and of birth, we are still conscious that we are possessed of a certain independent power of self-control, and we are sure that we can resist evil and overcome it. After we have become fully convinced of this power, and this obligation, we turn back with equally strong assurance to the facts, that we cannot escape, that come under the head of heredity and environment. We are sure that each one of us is born to be unlike every other, and that two exact duplicates of character are no more possible than two duplicates of features and muscles. Well, it is not worth our while to discuss the abstract problem, or try to harmonise the apparently conflicting facts of free-will and necessity. It is an old controversy, and never led to any definite end. The plan for us to work is clearly to study our own idiosyncrasies and to aim for the right. So far as our children are concerned, education should consider, first of all, what a child *is*, to begin with, and should aim at the correction of evil bias. But probably the most potent good that has come out of the study of heredity is the demonstration of our responsibility for the unborn. The progress of the human race largely depends upon assuring to the coming generations an honest prenatal stamp, a propulsion for goodness from the inception of existence. Science reiterates that no evil thought is ever indulged without it reaches beyond our power to control it. It is a fearful responsibility for one who is ever to be the parent of a beloved child to poison prenatally that very babe with his own base acts or base emotions. How fine should motherhood always be, and fatherhood as well.

SIFTINGS OF THE STUDY.

Glimpses into Nature's Secrets.

By Edward Alfred Martin.

(Simpkin, Marshall, and Co.)

The author of this well-written "popular science" brochure has a worthy claim to be considered an ardent lover of nature. It is not only apparent from a perusal of his writings, for he has paid her very close attention, but with all the ardour of a courtier he tells the world what he has learnt from her. His style is both fascinating, instructive, and entertaining. He begins by introducing us to the creatures of the sea-shore, and treats his subject minutely yet thoroughly—he has the happy knack of the *multum-in-parvo* style. From the sea-shore Mr. Martin wanders through a variety of subjects, and ultimately lands the reader at the Roman wall round London. Everything is of interest, and we regret that space will not permit us to quote some of his interesting chapters. We can, however, heartily commend it to the young scientist.

VOLUME I. OF "SCIENCE SIFTINGS" IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.
Or through any Newsagent.

Prizes for Amateur Photographers.

We include among our readers so many who practise photography, both for pleasure and scientific research, that we have decided to start a series of competitions, which we shall continue through the season if the interest is maintained. The first competition will consist of

Six Prizes.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co.) for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A camera for making enlargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a separate coupon, firmly attached thereto.

The last day for sending in photographs, slides, or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet Street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday, th, 1892.

HELPFUL HINTS:

Being Answers to Correspondents.

Questions to which answers are desired in this column must NOT *be marked "Science Queries and Answers."*

FARMER.—If you desire to "pull" your own sheeps' pelts we recommend you to proceed in the following manner:—Let the pelts be thoroughly softened, by soaking them for a day or two in water—if possible in running water. A latticed or perforated box sunk in a stream will answer for a vat. Then hang them close together in a warm and nearly airtight room, or, if no such room be available, in a tight wooden box. They will soon become tender enough to shed the wool easily—which can be ascertained by trying a lock with the thumb and finger—and it is important that they should then be pulled at once.

J. S. ROBINSON.—To fill in blemishes in mahogany or any other dark-coloured furniture, use a mixture of four ounces of beeswax, melted with a quarter of an ounce of powdered rosin. Add sufficient Indian red, or other similar colouring matter, with a little turpentine, to render the filling plastic and adhesive. It will dry quite hard.

M. L.—The so-called "spatter work pictures" are probably what you mean. Lay the pressed fern-leaves, etc., on a sheet of fine uncalendered drawing paper. Then, slightly moistening the bristles of a tooth or nail brush with common writing ink, or with any water-colour pigment, hold this over the paper, and draw a stick across it (the brush) in such a manner that the bristles will be bent and then quickly released. This causes a fine spatter of ink or pigment on the paper, which, when it is dry, and when the fern-leaf has been removed, marks the outline of the leaf pattern very accurately.

STATIMER.—To make carbon paper for copying purposes, prepare a stiff paste of lampblack or plumbago with pure lard softened by heat. Smear this thinly and evenly over soft writing paper, by means of a piece of flannel. The next day wipe off the superfluous portion with a piece of soft rag.

CURIOUS.—You can easily prepare the kind of "safety paper" that you mention, if you have access to a photographic burnisher. You may give the paper a preparatory dip in a strong solution of sulphate of iron, afterwards drying it thoroughly; but this treatment is not essential to the success of the subsequent operations. Finely powder some crystals of sulphate of iron, and spread a thin layer of the powder over paper, and force it as much as possible into the pores by rolling in the burnishing machine. Scrape the surface very slightly, and repeat the same process, using powdered ferrocyanide of potassium. Writing upon this paper with a pen dipped in plain water produces a blue colour, due to the chemical reaction of the ferrocyanide with the salt of iron.

S. JAMES.—A mixture of equal parts of alcohol and ammonia may be used for cleaning kid gloves.

PHOTO.—To make vegetable parchment, dip white unsized paper for a few seconds into a mixture of two parts (by volume) of vitriol to one part of water. Plunge the paper, immediately after removal from the vitroil bath, into a solution of very weak ammonia. Finally wash in plain water and dry.

COSMETIC.—Pure rouge is the only red that can be employed without injury to the skin. Of white powders we can only recommend starch and magnesia.

BETA.—To make the quinine and cod-liver oil compound, dissolve 40 grains of quinine in as small a quantity of pure alcohol as possible. Add one pint of cod-liver oil, and gently heat the mixture, with constant agitation, until the whole of the alcohol is expelled. It is best that the heating should be done over a water bath, but we recommend you to purchase the mixture ready made from a druggist.

HOUSEWIFE.—Baking powder is simply a mixture of about $\frac{1}{4}$ lb. tartaric acid with $\frac{3}{4}$ lb. bicarbonate of soda. Arrowroot or powdered starch is sometimes added.

ROBERT HENDERSON.—To make ink powders, which are very useful to emigrants and others, mix 4 oz. of Aleppo galls, $1\frac{1}{2}$ oz. of sulphate of iron, 1 oz. gum arabic, and $\frac{3}{4}$ oz. lump sugar, all quite dry and in powder. Divide this quantity into three packets. Each will be found sufficient for the preparation of a pint of good ink, by the addition of boiling water.

S. B. PHILLIPS.—It is stated that "Sanitas" contains a mixture of peroxide of hydrogen and camphoric acid. There can be no doubt that peroxide of hydrogen is a powerful oxidant and disinfectant. It can be obtained in liquid form from any wholesale chemist.

ROCHESTER.—To make drawing crayons, mix the colouring matter into a paste with a solution of 1 oz. Castile soap in a pint of boiling water, to which 2 oz. of melted spermaceti is added, the whole being briskly stirred up. It is not necessary to use a press for forming the crayons.

J. SNOWDON, E. KENNEDY.—Thanks for your letters.

M. N. S. S.—We are much obliged to you for the names and addresses. We have duly posted specimen copies to the gentlemen named. The letter we sent to the address given in your letter was, however, returned through the post office, with envelope marked "not known."

"CAPELLA."—Many thanks for your very kind expressions of appreciation. The price of our first volume is, as advertised, 3s. 6d., bound. Postage, 6d. extra. Our advertisement offices are at both 167 and 168, Fleet-street. Hence the apparent error.

COX AND CO.,

MANUFACTURING

Electricians and Opticians,

11, Fetter Lane, London, E.C.

Electrical and Scientific Apparatus of all kinds made and repaired for the trade. Telephones, Electric Bells, Batteries, Electric Light, Speaking Tubes supplied and fitted for the Trade. Estimates Free. Induction Coils and Medical Apparatus a speciality. Experimental Work of all kinds.

COX & CO., 11, Fetter Lane, London, E.C.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, $\frac{1}{4}$, 1/6; $\frac{1}{2}$, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. DALLMEYER "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, 25, NEWMAN STREET, LONDON, W.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.* 3 *months,* 1*s.* 9*d.*

Advertisement Offices: 167, & 163, Fleet Street, E.C.
" Sale and Exchange " Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

LONDON : SATURDAY, MAY 14, 1892.

SCIENCE NEWS AND NOTES.

" Wisdom is the principal thing: therefore get wisdom: and with all thy getting get understanding."
—PROVERBS iv. 7.

The Inheritance of Nervous Diseases

is absolutely denied by Dr. Pye-Smith, in a lecture just delivered before the Royal College of Physicians. He tells us that nothing but error and confusion can result from speaking of "nervous diseases" in general as inherited, as incident to a particular climate or occupation, or sex or age, or to ascribe them to intemperance, hard work, or any other cause; for the group is not a natural one, and can therefore have no common cause. The most obvious, frequent, and recognisable clinical disease of the brain is disease, from a medico-scientific standpoint, of the heart or blood vessels. In other cases the cerebral symptoms are due to tumours as accidentally present in the brain, as a bullet or a crowbar.

Some Nervous Diseases

may be described as exaggerations of individual eccentricities, of bad habits, involuntary gestures, and tricks of movement which have never been repressed by education. It is remarkable how often among the lower orders the natural beauty of a child's face is marred by its continual grimaces. An inexperienced speaker will betray his nervousness or enforce his conviction by twenty odd movements and ungainly gestures which, if they became fixed and habitual, might fairly be called spasmodic neuroses. Some of them are emotional outbursts, others are consensual movements dependent upon the law of irradiation by which a powerful motor stimulus is apt to overflow beyond its intended channels. To the first group belong the smiles, the tears, the shuddering, and the involuntary applause of the spectator of a drama or of the auditor of an oration. To the second, movements of the face, the hands, the arms, and the whole body which accompany the words of a public speaker. These, when properly restrained and disciplined, form half the power and the charm of acting or of oratory; but they have their origin in the uncouth movements of a clown at a fair, or of an illiterate person painfully composing a letter. These involuntary, emotional, or consensual movements may, Dr. Pye-Smith tells us, under certain circumstances, be developed into paroxysmal neuroses—on the one hand into spasmodic tic, on the other into hysterical convulsions; and in accordance with this supposed origin is the asserted fact that such functional disorders are more common in France and Italy than among the less emotional, less demonstrative, population of Great Britain.

The Relation of Physical and Mental Diseases

form the interesting subject of a recent paper by Dr. H. Grabham Lys. Digestion and mind particularly attract attention. The disorder of either digestion or mind will worry its fellow; irritability of temper may be attributed to indigestion on pretty ordinary principles; there is more difficulty in assigning the principles on which indigestion follows mental disturbance; but there can be no question of the fact. Maybe it checks secretion of the gastric juice. Physiologists do not indeed question a nervous influence on secretion and nutrition apart from vaso-motor change, though the question of separate trophic nerves may still be an open one. Mr. Hutchinson, at a meeting of the London Hospital Medical Society in 1888, dwelt on the influence of emotion on some of the secretions, and more especially instanced cases of persistent dry mouth following some mental shock. A chronic dry mouth would most probably end ultimately in an attack of dyspepsia, as the power of digestion is necessarily weakened when the food is not properly salivated.

The Physical Re-actions of Mind on Body

have been too much neglected. Dr. Lys cannot doubt that the imagination has a substantial influence over organisation and function. He believes that on it often depends the efficacy of a remedy. He endeavours to bring home the fact that mind and body are inseparable. There are diseases of body alone and diseases of mind alone, but there are numerous other diseases where the two are closely coordinated —some where the mental disturbance is secondary to bodily disease, others where the bodily disease is secondary to the mental disturbance. Alienist physicians continue to thrash out the former class, but general physicians have too much neglected the latter. The study of mental disturbance must afford to each practitioner of medicine not only most valuable indications for prognosis and treatment, but also no small field for that most conservative of all duties—the prevention of disease in the recognition of its cause.

Massage

is spoken of very glibly, but few understand that the word signifies motion and pressure applied to parts of the living body for curative purposes. Massage is the application of motion and pressure to the soft tissues of the body by the hand of the operator, and should be given under the guidance of the educated and experienced physician. Massage is not good for every disease which afflicts the human family, and a knowledge of anatomy and physiology is essential to the proper application of massage, which is based on plain physiological laws, and has nothing in common with magnetism; nor is it a form of exercise or gymnastics, or a system of rubbings. There should be no surface friction or skin rubbings in the proper massage treatment. In a general way, without going into details, it may be described as a

system of kneading, compression, rolling, wringing, percussion, and vibrating the soft tissues of the body. The Swedish movements are a system of slow motions with and without resistance, made by the director or physician. They are often combined with the massage treatment.

The Rationale of this Method of Treatment

is that the circulation is invigorated, oxygen is carried to the tissues more rapidly, the blood is purified more effectually, and the carbon and debris of the body are liberated more freely. This is done without any expenditure of will power or nerve force. Old adhesions are broken up, and inactive muscles are brought into action. The forces of the organism are mostly expended through the circulatory and muscular systems, and less vital energy is exhibited in the nervous. The expenditure of vital power is accelerated. It is a law of vitality—of all living things—that the development of vital power and strength is accomplished only by augmenting the expenditure of this same power. The athlete knows by continuous effort and exertion that by great expenditure of vital power he can gain the strength and power to perform his herculean task. So the horse trainer is aware of this law, and takes advantage of it in developing his horses. This is the philosophy of the massage and Swedish movement treatment. It is not only adapted to the sick and diseased, but is a method of treatment highly beneficial to the business man or woman whose incessant application in the office has enfeebled his or her vital energies, and made them feel the need of recuperating their physical powers.

The Smoke Nuisance Question

has brought forth from Mr. Robert Lee a condemnation of the open stove and soft coal. We are told that the first step towards curing the "smoke nuisance" is to make the public fully appreciate the fact that this custom is attended with such enormous waste and pecuniary loss as to make the matter of economy quite as deserving of thought as that of the "nuisance." It may be fairly calculated that no profit is derived from half the coal burnt in domestic fire places, that is so far as benefit is obtained for warming purposes. More than half the heat generated by the coal goes up the chimney, and is absolutely wasted. The actual cost of the coal in London must be over £2,000,000 per annum; and, if so, £1,000,000 is lost by waste. In order to perceive that this is a matter of medical interest, we must realise that in the use of open fireplaces the question of ventilation is involved to as great an extent as that of warmth; and it would be fair to ask whether sanitary requirements demand the amount of ventilation obtained by open fireplaces. If we go to the other extreme and consider the great defects in ventilation which attend the use of closed stoves, we shall be able to appreciate the nature of the problem which has to be determined.

Medical Science

has settled the question of ventilation, just as accurately as it has decided the areas, superficial and cubical space, which are necessary for apartments of all kinds. It would be quite easy to prove that open fireplaces produce an amount of ventilation which science does not require; and that while the stove on the one hand is seriously injurious to health, the open fireplace on the other is not only wasteful of heat and causes in one way too much ventilation, but is nearly as injurious to health as the other by the smoke it produces. To medical science, then, the public has a right to put the question: What amount of ventilation ought to be provided in an apartment of any given dimensions? and this being already answerable, the problem simply reduces itself to determining the mean between the open fireplace and the closed stove, or to such an arrangement as would reduce the waste of up-draught in chimneys to the requirements of health. There is a mean which can be arrived at without much difficulty. Let this question of waste, of gigantic useless waste, be appreciated by the public, and the remedy will soon be found.

Animals and Machinery

may be regarded as natural enemies or allies according to which way the matter is regarded. In a German engineering journal a writer contrasts the behaviour of different animals towards steam machinery thus: The ox, that proverbially stupid animal, stands composedly on the track of a railway without having any idea of the danger that threatens him; dogs run among the wheels of a departing railway train without suffering any injury; and birds seem to take a particular delight in the steam engine. Larks often build their nests and rear their young under the switches of a railway over which heavy trains are constantly rolling, and swallows make their home in engine houses. A pair of swallows have reared their young for a year in a mill where a noisy 300 horse-power engine is working night and day, and another pair have built a nest in the paddle box of a steamer which plies during the season between Pesth and Semlin.

The Bumble Bee

was introduced into New Zealand a few years ago to secure the fertilisation of the red clover, and the remarkable success of this venture are matters of record. In a recent paper in the *New Zealand Journal of Science*, Mr. George M. Thomson, F.L.S., presents an interesting article on the introduced Bombi in New Zealand, giving also a list of the plants and flowers which are visited by these bees. He makes the interesting statement that, with a few exceptions, he has never heard of these bees visiting the flowers of indigenous plants, but states that they have become so extraordinarily abundant that the question has even arisen in his mind as to whether they would not become as serious a pest to the apiarist as the rabbits have proved to the farmer and cultivator, on account of their absorbing so much of the nectar of the flowers. He also points out the remarkable fact in connection with the life of the bumble bee in New Zealand, that in many parts of the colony it does not seem to hibernate at all, but is to be seen daily on flowers all the year round.

The Detection of a Mirage

has puzzled many a traveller, and this is the method suggested by a correspondent to distinguish the real from the illusive. He says:—"If the mirage be near the horizon, as was the case in each instance observed by the writer in Southern California, the deception may easily be eliminated from the real by bending close to the ground and taking a view, then suddenly rising to the full height, keeping the eye on the scene in meantime. Then reverse the plan. Before bending very low, the false view suddenly "shuts out," or disappears as by a screen, while the real scene only disappears as terrestrial objects hide it. In certain instances it is well to add to the upright view by a jump if no object can be utilised. This experience adds to the novelty of a mirage, and is wholly convincing."

The Russians Have Made a Singular Discovery
in Central Asia. In Turkestan, on the right bank of the Amou Daira, in a chain of rocky hills near the Bokharan town of Karki, are a number of large caves, which, upon examination, were found to lead to an underground city, built, apparently, long before the Christian era. According to the effigies, inscriptions, and designs upon the gold and silver money unearthed from among the ruins, the existence of the town dates back to some two centuries before the birth of Christ. The edifices contain all kinds of domestic utensils, pots, urns, vases, and so forth. The high degree of civilisation attained by the inhabitants of the city is shown by the fact that they built in several stories, by the symmetry of streets and squares, and by the beauty of the baked clay and metal utensils, and of the ornaments and coins which have been found. It is supposed that long centuries ago this city, so carefully concealed in the bowels of the earth, provided an entire population with a refuge from the incursions of nomadic savages and robbers.

A Remarkable Shower of Mud
along the Union Pacific Railway at Onaga fell last month. The rain commenced early in the day, and soon the south and east sides of all houses were covered with yellow clay. The windows received such a coating as to shut out the sun's rays. A Union Pacific train which ran through the storm had its windows covered, and the headlight was so completely plastered that the light was shut in and the train ran in darkness to Rossville, the next station, where the mud had to be scraped off. This storm lasted until after daylight. As far east as Topeka, the windows showed that the edge of the mudstorm had extended this far. It was more severe about fifty miles north-west.

The Power of Niagara
is to be placed, as our readers are no doubt aware, to practical use. A company that has taken out a license for a portion of the power finds it no easy task to decide how the terrific power from the 138 ft. head of water which is to be at their disposal shall be utilised. At a recent conference of the officers of the company, about 20 wheels and methods of developing power were submitted to them, and all but three were immediately passed over as being wholly inadequate to the occasion. Most of the water-wheels made would crush like egg-shells beneath the force of a column of water falling 130 ft. down a penstock. The wheels selected for further tests are to receive it at Holyoke, and when a decision is reached the company's architect will prepare plans for several ways of using the power. The contract for building a coffer-dam for the company has been let, and also for the tunnel and shaft. The tunnel will be 500ft. long and probably 10 by 12 ft. in size. The shaft will have a depth of 140 ft., and will be 14 by 40 or 45 ft. in size.

Is Electricity a Myth?
seems a fairly rational question in view of our trifling knowledge of this immense natural force. In its practical, serviceable relations, however, it is assuredly no myth. But there is an active debate in progress among scientific scholars on the question whether there is after all such a thing as electricity—using the word "thing" as implying a material entity—or whether it is merely an effect, or, to speak more technically, a mode of motion. If the latter theory is accepted by the scientific world as correct, electricity will still be in very respectable company; for both heat and light have gone that way before. Not very long ago they were supposed, even by philosophers, to be actual substances, not exactly tangible or ponderable, but still having a positive material existence, and liable some day to be weighed and measured, manipulated and transported like any other commodities. Practically, of course, this is done when a ton of coal or a pound of candles changes hands. But in any of these cases it is only the vehicle or agent which is visibly dealt in; and it will only be by a figure of speech that we shall ever ask for a hundred-weight of heat, or a gallon of light. The analogies of the case seem to point to the same conclusion as regards electricity. What goes by the name of electricity may be generated and stored, and it is so treated for a multitude of familiar uses; but only, in this view of the case, as light is stored in a gas tank or warmth in a cord of wood. Possibly the question is not of much moment save as a topic of abstract controversy.

"When Bishop Berkeley says there is no matter,
It is no matter what Bishop Berkeley says."

But speculative inquiries such as this have often led and will in many future instances lead, to results of vast practical utility to mankind.

The Formation of a Vacuum
is one of the most interesting operations in the manufacture of incandescent lamps, and the life of the lamp depends more upon this part of the work than anything else. Human beings cannot live without air, but electric lamp filaments cannot live with air, the oxygen in the air which is so essential to the support of animal life is fatal to the life of an incandescent lamp filament. The carbon of the filament oxidises very readily when heated in the air, and for this reason it is necessary to confine it within a bulb from which the air has been exhausted. The exhaustion of air from lamp bulbs is accomplished by means of vacuum pumps, and it must be conducted with great care, as it is at this stage of lamp-making where the greatest difficulties are met. Mercurial pumps are used for the exhaustion of air, among the best known of which are the Sprengel and the Geissler. Mechanical pumps are usually employed to hasten the process in its first stages, mercurial pumps being afterwards used to complete the work. The mechanical pump cannot produce as high a vacuum as is necessary for lamps, while the mercurial pump can produce a higher one than needed.

The Geissler Mercurial Pump
is a modification of the apparatus used by Torricelli in his experiments which led to the invention of the barometer, the space between the top of the column of mercury in the barometer tube and the top of the tube itself being called a Torricellian vacuum. The Sprengel pump is somewhat simpler than the one just referred to, and is thought by many of those who have used both to be capable of producing a more refined vacuum. To give a general description of the action of these pumps in practical operation, it may be said that the bulbs to be exhausted of air are connected with that portion of the tube containing the mercury where the vacuum exists, and then in creating the vacuum, the air contained in the bulb is carried off with that in the tube. When the proper degree of exhaustion has been attained, the bulb is melted off at the neck by a glass blower, and the lamp is then ready to be finished. The process of exhausting the air from lamp bulbs is similar to driving a swarm of flies out of a room. It is a comparatively easy matter to get a large number of them out, but when few remain the hard work begins. So it is with the air in the bulbs. It is easy enough to get most of it out; the hard labour comes when we get to the last of it. After the air has been sufficiently exhausted from a bulb, there remains less than one-millionth part of the original quantity.

GLEANINGS OF THE GLOBE.

THE first matches were pieces of wood about six inches long tipped with sulphur. They caught fire easily from a piece of flint.

ZINC expands up to the melting point. A bar of hammered zinc six inches long will expand one one-hundredth of an inch in raising the temperature 100° F.

HALF a million pansies, 100,000 roses, and millions of other flowers, will be seen at the Chicago Exposition. The horticultural exhibit will be on a scale never before attempted in the history of the world.

WHOLE forests may be seen coated with shelly substances on the continent of New Holland. These encrustations are supposed to arise from decompositions of shell-fish, which, transported by the winds, are deposited in the form of dust on trees and plants.

THUS the *Horticultural Times* advises :—To tell mushrooms from toadstools (without eating and waiting for results), peel an onion, and put with it the fungi while being cooked. If the onion remains white, eat with confidence ; if it turns black, eat with an emetic or stomach-pump at hand.

A FRENCH technical journal recommends the use of coal tar soap for waterproofing masonry. A small amount of india-rubber dissolved in benzine will increase its durability. It should be applied boiling hot, and if the colour should be objectionable it can be dusted with plaster of paris before drying.

IN Popayan, lime is crushed very small and sold there to eat with the coca. When an Indian has a long day's journey before him, through forests and over mountains, he can go for several days without eating anything provided he has plenty of coca and lime with him. Its sustaining powers are said to be marvellous.

EXPERIMENTS on the ventilation of tunnels on Saccando's system have recently been carried out in Italy. In this system fans and ventilating shafts are dispensed with, but air is compressed into a reservoir outside the tunnel, to which it is led in suitable mains. From these mains it is allowed to escape at different points inside the tunnel, force from it drives out the foul air.

THE quantity of cow's milk available for consumption in this country has been estimated at 1,417 million gallons per annum. Out of this quantity, only 570 million gallons are consumed as milk. Butter takes up 617 million gallons, and cheese accounts for another 224 million gallons. The remaining 6 million gallons are used for miscellaneous purposes, such as condensed milk, etc.

MANY people are puzzled to know if a vessel goes faster with the tide than against. This, says a contemporary, is certainly not borne out by facts. A steam launch made two runs with the tide against it with just one-fifth of a second difference in her speed. We are not sure, however, that any such popular belief exists in this country, as regards speed in the water. A fly crawling on a table cloth makes the same progress over the surface, whether the cloth be moving or at rest, and a steam launch is in the same relation to the water through which it moves.

THE average speed of the Gulf stream is said to be 3 miles an hour, although at certain places it attains a speed of 54 miles. In the Yucatan Channel, for instance, where it is 90 miles wide and 1,000 fathoms deep, the current is not over a quarter of a mile an hour. In the Straits of Bemini the current is so rapid as to give the surface of the water the appearance of being a sheet of fire.

"CAREFUL students of the history of thought and the progress of science may possibly have noticed," remarked Mrs. Besant, at Glasgow, "that the last quarter of each century has been marked by a somewhat sudden advance. Theosophists account for this by stating that there is in the world a brotherhood of teachers who hold in trust a great body of philosophical and scientific knowledge, which they impart to the world gradually."

THE dust scattered everywhere in the atmosphere, and which is lighted up in the sunbeam or a ray from an electric lamp, is of an organic nature. It is seen to consist of countless motes, rising, falling, or gyrating, although it is impossibe to follow any of them with the eye for longer than a fraction of a second. It is difficult to say how much of the dust present in the air may become a source of disease, and how much is innocuous. Many of the motes belong to the class of micro-organisms which are frequently the means of spreading infectious diseases.

INVENTORS of explosives are now a drug in the market, for this reason, we suppose, they are turning their attention in another direction. An anti-explosive is the latest and most seasonable development of this revulsion of taste. The exact nature of the compound is not made known, for obvious reasons, but it is stated that its power of interference is great and undoubted. The expansion of gases caused by the explosive is lessened, it is claimed, by a process akin to liquefaction. We feel interested to know more about this discovery, and shall await developments with interest.

A MEDICAL writer says:—If mothers notice that the brains of their little ones conjure up uncanny sights and thoughts from the shadows of a room more or less dark, let the light burn brightly. To force a child to become accustomed to the darkness is a grave error, if its nervous system is so organised that this forcing is productive of fright. The nervous system of a child is a very susceptible organisation, and the deleterious impressions made upon it will often make their influence felt throughout its whole after-life. If the child asks for a light under such circumstances, *do not refuse it.*

PROFESSOR KIRCHOFF, in his paper on "Motion of Electricity in Wires," first showed in 1857 that, under certain conditions, electricity moves in a thin wire according to the laws of wave motion and with a velocity about equal to that of light. This, however, is only true of straight wires stretched in the air. He found that if the wire be in a zig zag form, or wound in a spiral, the velocity of propagation exceeded that of light. Professor J. Stephan has recently been studying the same question, using the method of Hertz, viz., of producing stationary waves and comparing the length of the waves in straight wires with those in circuits. He finds them longer in the latter than in the former, and the increased velocity of propagation in the latter over light, much greater than that given by Kirchoff or Wheatstone, who has also investigated the subject.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when a similar question or reply is sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 28.

91.—What is supposed to be the cause of the aurora borealis?

Aurorae are undoubtedly caused by electrical discharges or currents, taking place between two portions of the atmosphere in which the suspended particles are at different electric potentials. Atmospheric electricity is fully accounted for by the natural processes of evaporation, etc., particularly by the evaporation of sea-water. Local concentration of the intensity of this electrification is accounted for by the coalescence of charged particles of water. Still it cannot be asserted that all the circumstances attending the auroral discharges are as yet fully understood. One thing is known; that the colour of the discharges depends almost exclusively upon the elevation at which they take place. And it is probable that the red-coloured aurora may take place at a height of about 12 miles, carmine at from 13 to 31 miles, salmon-coloured 33 miles, pale salmon 34 miles, very pale and faint flashes at about 80 miles. The maximum brilliancy is probably at a height of about 38 miles. It should be added that the popular belief in a connection between auroral discharges and disturbances of terrestrial magnetism is based upon a very shadowy theoretical foundation, and that it is as yet unsupported by any series of reliable observations.

92.—How are the little electric batteries of thimble size constructed?

The query probably refers to one of Trouvé's batteries. The thimble is made of ebonite, or other non-conductive and impervious material. It contains a disc of zinc and one of copper, separated by a number—say 50—discs of blotting paper. The 25 absorption discs next the zinc are moistened with a concentrated solution of chloride of zinc, the 25 next the copper with saturated solution of sulphate of copper. Nothing more is necessary except that the outer surfaces of the metal discs should be connected with the "binding screws" of the battery by short lengths of gutta-percha covered copper wire. An alternative plan is to use a copper thimble, having an ebonite cover, through which a short stud of zinc is introduced. This battery is charged with salt and water. The zinc stud constitutes one of its electrodes; the copper thimble itself is the other.

93.—Is homœopathic medical treatment based on reasonable theoretical grounds?

That the specific grounds for at least some instances of homœopathic treatment must be considered wholly unreasonable may be inferred from the following considerations. When a single grain of, say, atropine is dissolved in a gallon of water, and one drop of this solution is added to another gallon of water, we have what is called in homœopathy a "first dilution." If a drop of this is added to a third gallon of water we have a "second dilution," and so on. Tenth dilutions are said to be sometimes administered. And it can be easily calculated that, taking the diameter of a drop as $\frac{1}{8}$th of an inch, there must be, in a drop of the "tenth dilution," about $2/10^{60}$ of a grain of atropine. But this is a totally impossible quantity. For if the drop of water were magnified to the size of the earth, and if the atropine in it were magnified to an equal extent, then the size of this magnified particle of atropine would correspond with that of a sphere about one three-billionth of an inch in diameter. According to Prof. Tait's estimate, the size of the chemical atoms in the water thus magnified would correspond with that of a sphere nearly one foot in diameter. The size of an atom of atropine ($C_{17}H_{23}NO_3$) would be something considerably greater than this. And it is, of course, difficult to believe that one atom, or even any inconsiderable number of atoms, of dead matter, introduced into the stomach, could exert any appreciable effect of any sort upon the human system.

94.—How is it that heavy particles of water are suspended in the air in clouds?

The fact is due to the resistance opposed to the fall of the particles by the viscosity of the air. Professor Stokes has calculated that a droplet of water, a thousandth of an inch in diameter cannot fall, in still air, at a much greater rate than an inch and a half per second. A droplet of one-tenth of this volume will fall a hundred times slower, that is to say, at the rate of not more than one inch per minute. Hence the very slow rate at which clouds fall, even when they are composed of particles considerably larger than those mentioned, can be readily understood.

95.—What is the highest temperature that can be endured without injury by the human frame?

Men have remained for nearly an hour in a room heated to 320° F.—a temperature of the air by which beef steak was cooked in thirteen minutes. The clothes give no inconvenience in these circumstances; but if any good conductor of heat, such as an article of metal, be touched, the result is a severe burn.

96.—What causes the "Will-o'-the-Wisp"?

The "Ignis Fatuus" results from the liberation of phosphorated hydrogen gas at the surface of the earth or of water. Phosphorated hydrogen is a product of the decomposition of animal matter, and is evolved under the most favourable circumstances for luminous combustion when this decomposition takes place at the bottom of a pool of stagnant water. The gas is then liberated in bubbles of considerable size, which rise to the surface of the water, and take fire immediately on contact with the air. Besides, a considerable quantity of marsh gas (light carburetted hydrogen) is usually given off at the surface of such pools; for this is one of the principal constituents of decomposed vegetable matter. Marsh gas is inflammable, although not spontaneously inflammable, in air; and the ignition of the phosphuretted hydrogen serves to set the marsh gas also on fire.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

103.—At what rate is the speed of rotation of the earth decreasing?

104.—In what different senses is the word horse-power used by engineers?

105.—What is the astronomical significance of the aberration of light?

106.—Is it known, or can it be ascertained, what is the highest altitude at which a man can live, or to which a bird can fly?

107.—How is the length of the seconds pendulum accurately measured?

108.—By what means can the finest metal wire be made?

PROFESSOR GARNER AND THE GORILLAS.

Professor Garner, whose projected trip to Africa, to study gorillese, has already been reported on by us, has given an interesting account of his early experiments into the study of the speech of the lower animals which commenced some eight or nine years ago. His experiments have been to a large extent among the monkeys, though other classes of animals were also experimented on. The first principle to be understood in beginning the study of the speech of animals is to associate the act with the sound, when the notes indicating anger desire and fear may be undestood. All researches of this nature must necessarily be crude, but about two years ago Mr. Garner conceived the idea of using the phonograph to record and analyse the sounds. The phonograph affords an unquestionable proof that certain sounds are accompanied by a definite act or gesture, as when the phonograph gives the note of fear, the monkey gives unmistakable signs of fear. The phonograph thus relieves the difficulty of having no standard or phonetic base upon which to work. The analysis of sounds on the phonograph is accomplished by the differences in speed of rotation of the cylinder, which may be increased or decreased from 40 or 50 to 225 revolutions per minute. Human laughter on the phonograph cylinder by proper manipulation easily deceives animals.

The professor's description of his method of obtaining a record of the sounds is very interesting. A mirror is hung on the horn of the phonograph, which induces the monkey to believe that another monkey is present, when the phonograph begins to utter sounds. When anything suspicious occurs, the monkey warns his friends in the mirror, of whom he seems very fond, lavishing caresses upon him, monkey fashion. A point of great value in Mr. Garner's researches is that monkeys have three or four inflections of the same sound, each with a meaning of its own. If the value of the sounds are considered as Mr. Garner states, it is true speech. Mr. Garner makes no claim that monkeys or other animals have definite sounds for the kinds of food, as bananas, but that they divide food into sweet food, etc. This speech of animals is a marked contrast to the redundancy of human speech. Monkeys speak, if the term may be allowed, in syllables, the word for food having five or six syllables.

Mr. Garner states on the authority of Frank Cushing, the celebrated white Zuni chief, that the Zuni Indians not only know the language of animals, but put this knowledge to practical use.

INDEXES TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. I, price 1s., post free, 1s. 2d.

MYSTERIES OF THE OCEAN.

A few years ago, when the steamer "Gazelle" was dredging the depths of the Southern Atlantic, many hundred of miles from land, the scientific staff was greatly surprised to haul up from the sea bottom many grains of quartz. These heavy deposits could not have been carried from the land, for the ship was far north of the track of the antarctic icebergs. It was believed this quartz in the middle of the ocean might afford another proof that igneous or eruptive rocks, now and then, are thrust by subterranean action up through the deposits on the ocean bottom. Another explanation of these quartz finds was advanced. Suppose a ship with sand ballast was lost in the middle of the ocean. In that event its millions of quartz grains would be sifted over the sea bottom; which goes to show that scientific men cannot always, with safety, attribute to mighty phenomena the accidental finds they make.

The science of oceanography is still young and, strangely enough, it was not naturalists, but engineers, who first began to explore the ocean depths. It was when the first submarine cable between Europe and America was laid that the scientific world turned its attention to the study of the ocean abysms. The English vessel "Porcupine," in 1869, fairly ushered in the era of deep-sea research. Then followed the memorable expedition of the "Challenger" in 1872, and later came a crowd of investigations in every sea.

It may be said that in their broader features the contour of the ocean bed and the phases of deep-sea life are now revealed. Here are some of the most interesting facts that have been learned:—

It was supposed a few years ago that the ocean bottom was largely a counterpart of the land features of the globe, with its mighty mountain ranges pushing up towards the surface of the sea, and deep valleys and glens sinking to almost unfathomable depths. This is found to be true only to a limited extent. Here and there, to be sure, mighty mountains push towards the surface or rise above it, forming islands; and then again the bottom sinks in a narrow trough, as off the north-east coast of Japan, until it seems as though the sounding line could never measure its depth. But the ocean bed, in the main, is found gently to undulate, and would present the appearance, if it could be observed, of a slightly rolling plain.

It has been found also that we used to have very exaggerated views of ocean depths. Moury, in his day the great authority upon the ocean, popularised the idea that a depth of eight or nine miles might be found in mid-ocean. We know now that a depth of five miles is very exceptional. Gen. von Tillo, who has made the latest determinations of ocean depths, fixes the mean depth of all the oceans at 3,803 metres, or about 12,700 feet, less than two and a half miles. The Pacific Ocean averages about 1,100 deeper than the Atlantic. The North Atlantic is deeper than the Southern Atlantic, and the Arctic Ocean grows shallower the nearer the pole is approached.

Very interesting facts have been discovered with regard to the great distances from land at which the sediment brought down by mighty rivers is spread over the sea bottom. Those giants among rivers, the Niger and the Congo, produce most marked effects upon the nature of the deposits at the bottom of the ocean. Buchanan has found that the sea bed for hundreds of miles from land, from the Gulf of Guinea to Loanda, has been filled up to an enormous extent by the dark coloured, soft muds brought down by the rivers, and off the mouth of the Congo the shore mud has been traced to a

depth of 18,000 feet, at a distance of 600 miles from land. In the Bay of Bengal and the Arabian Sea the sediment from the Indus and the Ganges is spread out over the greater extent of the ocean's floor. Antaretic iee brings as far north as 40 degrees south latitude the debris from lands perhaps still unknown. Dr. Murray says, however, that toward the central part of the oceans it is difficult to trace the ordinary river detritus in the deposits there forming.

Before the "Challenger" expedition only six deep-sea fishes were known. To-day about ten times as many forms of deep-sea life are familiar to oceanographers. We can form some idea of the abundance of life existing in some regions at a depth of two and a half miles, when it is said that at a single haul of the trawl only 12 feet wide, and dragged over the bottom for a very short distance, as many as 150 specimens of the higher forms of deep-sea life have been obtained.

One very interesting fact seems to have been established by the recent investigations in the Paeifie of the United States Fish Commission steamer "Albatross." It has long been known that the group of animals characteristie of the upper part of oceanic waters is entirely distinet from the forms of life near and at the bottom of the sea. The "Challenger" investigators thought they had established the faet that another distinct group of animals exists in the intermediate depths between these upper and lower forms of life. This theory seems to have been upset by the work of the "Albatross." The naturalists of this vessel have found that the forms of sea life in the upper portion of the ocean waters may deseend to a depth of 1,200 feet or so from the surface, but there then succeeds a barren zone which continues to within 360 to 300 feet from the bottom where the deep-sea animals begin to appear.

As a rule these deep-sea animals have no eyes, showing that they have no need of them. The faet that they are subjected to enormous pressure is shown by many of them bursting open when brought to the surfaee. Some of them have very bright eolours, and they are found most abundantly along the courses of the great currents, showing that these rivers in the ocean bring a large amount of food for the deep-sea fauna.

A narrative of the minor and curious incidents of deep-sea exploration would make an interesting story. It was a distressing, though rather ludierous, mishap that befell Dr. Hansen, who unfortunately wrote his labels and description of the sponges collected by the Norwegian North Atlantie Expedition in fugitive ink, and the reccrds of his work became indeeipherable. One thermometer now in use registers the temperature at any desired depth, by means of a weight sent down the line at the depth required, and striking the thermometer inverts it. Some time ago a small flat fish was investigating the instrument at a depth of 1,200 feet, when the weight deseended and eaught the animal. From the standpoint of a deep-sea fish, it seems hard that an animal living so far from the resources of eivilisation should be exposed to aeeidents by machinery.

These dredging expeditions have demonstrated the interesting faet that the knowledge of deep-sea deposits has now advanced so far that experts at home, from the examination of a speeimen, can tell approximately at what depth and in what latitude it was taken, and, with certain reservations, can roughly determine the longitude. To give an illustration or two—in tropical regions distant from land, and at a depth of 18,000 feet, the deposit seems without exeeption to be a elay arising from the decomposition of voleanic matter. In the greatest depths there is hardly a trace of carbonate of lime, but at depths of 12,000 feet more than half of the deposits eonsist of this. Within 100 to 150 miles of land all the pelagie organisms are more or less completely hidden by the large amount coast or river debris with which they are mixed.

One vessel, the "Dolphin," found a depth of 20,646 feet south of the Azores, which was the greatest depth discovered during its long cruise. The "Seine" discovered that the now famous Trinidad depression (over 20,000 feet) was not so extensive as it is represented on the maps. The "Pola's" investigations in the Eastern Mediterranean resulted in recording the depth of 13,316 feet, the greatest depth yet found there, and the great depression in this sea must therefore be moved quite away east from its former central position on the maps. The Black Sea has been gridironed by lines of soundings, and the important faet has been discovered that below 600 feet there is no organic life, the lower stratum of water being so much impregnated with sulphuretted hydrogen. An important series of soundings between the Bermuda Islands and Nova Scotia was made when the "Westmeath" laid the cable that now connects Bermuda with the rest of the world. The work of the "Fylla" in Denmark Strait, between Greenland and Iceland, had the important result of showing that the warmer Atlantic waters pass north through the strait under the surfaee polar stream flowing south.

The oceanie studies referred to here are only a small part of the work of these expeditions. They have been rich in results eonecrning the nature and extent of the eurrents, the eolour and transpareney of sea water, the temperature at various depths, polar iee, the formations and dimensions of waves and various other phenomena; and the extensive literature now aecessible, relating to the sea in all its aspeets, shows that rapid progress is making in oceanography, the youngest of the seienees.

Prizes for Amateur Photographers.

We include among our readers so many who practise photography, both for pleasure and scientific research, that we have decided to start a series of competitions, which we shall continue through the season if the interest is maintained. The first competition will consist of

Six Prizes.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co.) for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A camera for making enlargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a separate coupon, firmly attached thereto.

The last day for sending in photographs, slides, or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet Street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday June 28th, 1892.

PERPETUAL MOTION.

Periodically we find in most of the journals devoted to mechanical science and trade the announcement that some bright genius has invented perpetual motion, many of them illustrated by elaborate drawings; but in every instance that same announcement will state that the machine or device is not quite completed, but lacks only some small alteration or addition in order to render it perfect. With this statement the matter ends, and we never hear any more of it, from the fact that the small addition required to make it perfect is never found, and it drops out of sight like a meteor when the inventor can find no more dupes to invest their money, and we hear no more of it. This is the history of all such inventions up to the present time, and will be for all time to come.

Now it is strange that any man with the least knowledge of mechanics cannot understand that in order to obtain perpetual motion the well-known laws of nature, which are as fixed and unchangeable as the laws of the Medes and Persians, cannot be changed or overcome. The three principal forces which act against it are first the attraction of gravitation, second friction, and third atmospheric resistance, and no machine or other device for generating motion can be constructed in such a manner that one or more of these opposing forces will not be met with. Atmospheric resistance, it is true, may be reduced to a minimum by working in vacuum, but as a perfect vacuum has never been obtained in a practical manner the resistance from this force can never be entirely overcome.

Even if it could be, still the attraction of gravitation and friction are there, which in time will bring every moving body to a state of rest, and there is no possible manner in which these two forces can be neutralised. A pendulum vibrating in a vacuum will continue to vibrate longer than in the open air from the fact that friction may be reduced to a minimum by the use of a light spring, while atmospheric resistance may be nearly overcome by the vacuum, yet the attraction of gravitation is still there to operate against it at every vibration, thereby causing each one to become shorter, and without sufficient impulse to overcome this force, it will, in a short time, find its centre of gravity and the vibrations cease altogether, and it will remain in a state of rest. What is true of the pendulum is also true with every other mechanical device where motion is concerned, and these facts are known and recognised by all scientific practical mechanics.

But the inventors of perpetual motion are not, as a rule, so obstinate, unless it may be occasionally one after the Keely order. This class, however, should not be classed as mechanical inventors, but rather as mechanical frauds. They know very well that perpetual motion is out of the question, and the mysterious forces which they claim to have discovered, and which they so carefully guard and pretend to conceal from the public, are only calculated to deceive those who are not well versed in mechanical science, and the mysterious combination of wheels, cranks, levers, and other mysterious devices are only calculated to further their plans for obtaining money without returning a just equivalent. As these men are generally good talkers they not unfrequently, by an obstruse course of reasoning, succeed in convincing many who should know better, that a small amount of money is only necessary to perfect the device when large fortunes may be realised by all who may be interested in it.

In this manner companies have been formed and large sums of money invested, when at the same time the inventor well knows that the whole scheme is a fraud. But he will go on experimenting, *à la* Keely, so long as the shareholders possess sufficient gullibility to invest their money; in the meantime the so-called inventor is making a good living out of it with but little labour on his own part, aside from talking, so long as the funds last or until the whole thing is exploded. It is astonishing how long such men will keep up the delusion and obtain money before that takes place. It is unnecessary to refer to the Keely motor as one of this class of frauds, but certainly Mr. Keely has manifested a great amount of skill and shrewdness with his motor in moving the money out of the pockets of his patrons into his own, whether he ever succeeded in moving anything else.

Perpetual motion is, in short, one of the impossibilities of science; and we strongly advise those who are inclined to waste their brains—always supposing them to be worth anything—in the pursuit of this chimera, to save their money, labour, and consequent disappointment.

SOCIAL SCIENCE ON THE STAGE.

Henrik Ibsen is the great social scientist of the stage. If all his social problems are not pleasant to contemplate, they are, at least, earnestly drawn and painted from life in a life-like fashion. They are, in fact, the impressionism of dramatic art. "The Doll's House," now playing at the Avenue Theatre, has been toned down, and beautified in many respects, as compared with the original. Masculine egotism and feminine lack of logic, end in the loss of love by the wife, and the play resolves itself into this problem of marriage: Should the wife continue to live with the husband when love has flown or is proved to have been illusive. The relationship is held to be so immoral by the wife that, children or no children, she breaks it, until she shall have developed and the husband shall have reformed. If this solution of the problem is not an ideal one according to the light of modern stage fiction, and the first duty it is urged a mother owes to her children, it is at least poetical. We cannot expect logic where two distinct and antagonistic courses of duty have to be taken. Anyhow, the play is pleasant in the extreme, and its production a work of art. Miss Jane Achurch, the exponent of Nora Helmar, must have been, one could almost imagine, in the "Master's" eye when he created the character.

THE FECUNDITY OF FLIES.

The common house fly does not, in the ordinary sense of the word, migrate, though, of course, individuals of the species frequently travel long distances. The remarkable fecundity of the fly is quite sufficient to account for its numbers during the early summer. A few individuals, in the torpid state, survive even the coldest winter, and with the first warm days of summer lay their eggs. When deposited under favourable conditions these are hatched in from twelve to twenty-four hours, and in twelve days the worm changes into a nymph, and in ten days more into a perfect fly. A fly will lay four times during the summer, about eighty eggs each time, and careful calculations have demonstrated that the descendants of a single insect may, from the 1st of June to the end of September, exceed 2,000,000. Were it not for bats, insect-eating birds and the innumerable microscopic parasites with which the fly is particularly afflicted, there would be no worse pest in the world than the fly.

MORE ABOUT FLYING SHIPS.

The idea of eonveyanee through the air originated in the crude eoneeption of flying long before the Christian era, at a time when little or nothing was known of the laws and forces of nature. Nevertheless, that idea has eome down to our time developed to the eoneeption of air eonveyance by means of vehiele, while eountless other ideas have been exploded, and to-day its eventual realisation is looked for by the intelligent throughout the eivilised world.

The eoneeption and development of that idea are readily accounted for. The wonderful feats of the bird in the air incited man to the idea of flying—to assert his aseendaney over the feathered brute, just as eonsiderations of safety and mastery impelled him to the invention of the deadly weapon to vanquish the fierce quadruped. Naturally enough, he attempted the exeeution of the idea, and though he did not sueeeed, the very failures beeame additional ineentives to renewed efforts, until, at last, the wonderful invention of the balloon gratified his ambition to reach the elouds. The balloon thus embodied the idea of air conveyance by vehiele, and sinee late years the idea has assumed more praetical shape. The balloon has eome to be reeognised as only a partial sueeess ; none the less air eonveyanec has obtained a firm hold upon publie sentiment, and to-day it is unanswerably argued that the air, like steam and eleetrieity, is for our use on the eondition that we obtain sueh use as we obtain everything else in nature, namely, by our own effort, and that with the ever present object lesson of flight before us, it will be but a matter of time and growth for the mind, with its unlimited creative power, to discover and apply the means and eonditions with whieh man will master the brute in air as he has long sinee mastered it on land.

The achievement of air conveyanee is a physieal feat which involves the use of an air vehicle and the application of mechanieal power, both eonformably to natural law. The law requires the air vehicle to have weight of body ; that is, the same proportion of weight to volume of body with the land vehiele. Loeomotion requires locomotive power, and, reeiproeally, locomotive power requires locomotive work ; this consists in the eontinuous disturbance of the adhesion of the locomotive body to its element of loeomotion, here the air, and this adhesion results from and is proportionate to the weight of the loeomotive body, here the air vehiele. Hence, if this weight is disproportionate to volume, so as to result in levitation of vehiele, then the loeomotive power beeomes, to that extent, useless for want of work, while also the air vehiele is rendered unable to cope with the resistance to be encountered in speed and from other causes. Therefore, in air, as on land, the weight (gravity) of the vehiele is at onee the main impediment and indispensable requirement to its propulsion. Let it be noted, then, that the natural law condemns the balloon and, indeed, any air vehiele that floats, whether by means of a lighter substanee than air or by means of a vaeuum.

Requiring thus the air vehiele to have weight, natural law further requires an additional factor besides propelling power, in order that this may effect the propulsion of the air vehiele. If this factor is known at all, it certainly has never been explained; moreover, in all the published attempts at air conveyance, made and contemplated up to the present time, that factor is entirely ignored. It has been termed fulcrumage, and it is that which eauses the propelling power to act against the vehicle. In land conveyance fulcrumage is obtained by the adhesion of the vehicle to the ground, resulting from its weight. But in air conveyance fulcrumage is afforded by the air, and it is the bearing, sustaining, by the air of the propelling power, which is so applied as to be exerted against the air, and, through its sustenance by the air, to aet (re-act) against the air vehiele.

We have seen that natural law requires a heavy vehiele and fulerumage in air as well as on land, and in its very nature the fulerumage of the air must be adequate to render air eonveyance practical. Fortunately, it is adequate and without slip, as the numerous phenomena of birds of prey in the air, such as soaring, carrying prey, often heavier than the bird, at a speed of more than 100 miles an hour (both being feats of the vulture), conclusively attest. We will endeavour to further explain this. With the dawn of physieal knowledge, it eame to be gradually pereeived that the atmosphere is a physical substance and, as sueh, susceptible of investigation. And in the seventeenth eentury two inventions were made contemporaneous and elosely related to another, the importanee of whieh, it is safe to say, is not, even to-day, yet appreciated. We refer, of eourse, to von Guerieke's air pump and Torrieelli's vaeuum barometer. This last invention diseloses the air as a potent force, while the first brings forth the means, namely, vacuous space, through which the atmospherie force is obtained. It is only comparative reeent that those inventions have been turned to the practieal aeeount of utilising atmospheric air, by means of the vaeuous tube, as a force for the conveyance of light freights over short routes.

Yet, in oblivion of these facts, the air is still regarded by all the world as nothing better than a highly tenuous fluid, which is unable to bear weight greater than itself, and which resists foree only in proportion to the velocity of impaet. A contemplated invention of air conveyanee is predicted upon the assumption that it requires one horse-power to merely sustain in the air a 200 pound weight ; and, while that author claims success for his invention, he distinctly disclaims being unable to earry passengers for a long time and freight ever. Of course, his invention ignores fulcrumage, and is to be built in Paris, beeause, as he tells us, that eity exclusively affords the faeilities for that purpose. Thus, notwithstanding the inventions and diseoveries already made about the air, its meehanical charaeter is still totally misapprehended.

But it is only in its normal state of rest or equilibrium that the air is impotent. Subjected to the condition of vaeuous spaee, the air beeomes a potent foree by reason of its inherent energy to rush into vaeuous space with the enormous estimated velocity of 1,300 miles in an hour ; and if the air is prevented from entering vacuous spaee, it exerts against such resistance a pressure of 2,116 pounds to the square foot.

It stands to reason, however, that the air, having sueh a potent energy, is also able to sustain a force equal to that which, by means of the vacuum, it exerts. Nor is it remarkable that there should be means through which the air sustains force, and that such means should be obtainable by art, any more than that vaeuous space is the means through which the air exerts force, and that these means are obtainable by art. In other words, while there are means through whieh the atmosphere beeomes a potent force to the extent above stated, there are also means through whieh the air becomes unyielding to force to an equal extent. This unyielding state of the air, and the means for obtaining it, a seientist claims to have diseovered and named anthexis, from the Greek, meaning that which sustains force without yielding. Anthexis, we are told, like the density and force of the air, deereases with altitude, sustaining at sea level a force of 2,116 pounds, and at a height of 20,000 feet a force

of 1,100 pounds to the square foot of impinged air.

This discoverer believes he has sufficiently tested the means for obtaining anthexis to be sure of their efficacy; that these means are embodied in the wings, propelling machinery, and rudder of his invention of air car, and that through those means he obtains anthexis underneath the wings and against the propelling machine and rudder—that is, the atmosphere becomes unyielding to the weight of the wings, plus the weight of the air car which rests upon the wings, and plus the fulcrumage required for the ascent and descent of the air car; and the atmosphere becomes, likewise, unyielding to the power of impact exerted through the propelling machine and rudder. He adds to this explanation of anthexis the statement that the means for obtaining it are other than force; moreover, those means are constant, permanent, not liable to be impaired, yet readily replenishable.

Given anthexis, construction and dimensions of air car, its equilibrium in the air, its carrying capacity, its ascent, descent, and speed and other conditions are suggested as matters of course by the emergencies of use, if not, by the mechanical invention to which we have referred, through which anthexis is utilised. And being thus matters of technical routine, they form no necessary part in the description of the physics of this system of air conveyance.

MARVELS OF THE MICROSCOPE.

If a single hair of wool be examined through a microscope it will be seen to consist of a central stock, with apparently a large number of branches starting from it in every direction. It is this peculariry of wool which renders it so valuable in making felt. When a mass of wool is mixed together and pressed with the hands, the fibres intertwine and the projecting branches interlock in such a way that with a little pressure the whole will condense into a solid mass. The machinery for making felt takes advantage of this peculiarity of the wool and condenses the substance into a fabric of wonderful density and strength. But were it not for the branching nature of the woolen fibres and there disposition to interlock with each other, a mass of wool would have no more cohesion than a mass of cotton threads.

TO OUR READERS.

A Two-Guinea Portrait Free.

The Proprietors of "Science Siftings" will present a beautiful porcelain portrait, free of any charge whatsoever, to every reader of the paper who forwards three annual subscriptions of 6s. 6d. each, or six bi-annual subscriptions of 3s. 4d. each. These may be canvassed among friends, and a triple object will be served: the friends will be enlightened, "Science Siftings" will be helped onward, and a free portrait secured by the canvasser:

The liberality of this offer will be appreciated when we state that these portraits cannot be procured in the ordinary course of business under two guineas each. They are artistic portraits, beautifully finished by hand, on porcelain panels, measuring the size of this page (10 inches by 8 inches).

Another Offer.

Our object in making this offer is to cause people to talk about "Science Siftings," and thus to promote the circulation. It will be manifest that we lose money by each portrait. This, however, makes people talk about the portraits, and, hence, about the paper. We will, therefore, send to those readers who cannot induce their friends to subscribe to "Science Siftings," a portrait on receipt of 7s. 6d. to cover the cost of the porcelain panel and postage. The portrait will then be free.

Send a good portrait with the order, and the clearer this is, the better the enlarged porcelain portrait will be.

THE PHILOSOPHY OF VISION.

A correspondent gives some interesting reasons for the much larger appearance of the sun and moon when in the horizon than when high up in the sky. He does not think it is due to the atmosphere acting as a magnifying lens. He says:—If they are magnified by the air at the horizon, then they will subtend when seen at that point a larger angle when measured by a theodolite or any instrument adapted to measuring angles. In the absence of costly instruments, a simple one can be made to show that the enlargement is wholly deceptive and not a real magnification. Take a flat stick like a ruler, some two feet long or more, and at one end fasten a piece of tin or card with a small orifice, say one-eighth inch, placed so as to look along the length of the rule; then, about two feet from this peek-hole, place two pins in the wood, just far enough apart to take in the moon at the horizon when the eye is at the peek-hole. They will be a little less than one-half inch apart if two feet from the peek-hole, for the apparent diameter of both sun and moon is about one-half degree.

Now, with the same apparatus, look at the moon when high in the heavens, and it will be found just as large as at the horizon. Why, then, the great apparent difference? To answer this we must consider some of the laws and principles of this wonderful sense of vision. First, we judge *primarily* of the size of objects by the angle of vision they subtend; but with a given object, experience soon shows us that this angle varies inversely as the distance, and we learn to make allowance for distance when judging of size. Thus, the tip of my little finger, when held arm's length from my eye, covers up entirely a large dwelling-house about one mile distant; but as I look at the house it appears full size, and I should never think of calling it as small as my finger tip. Why? Because I learned to unconsciously allow for its distance. The same principle is illustrated in the answers given to the question, "How large does the moon look to you?" The answers vary from a tea saucer to a cart wheel; but the tip of the little finger when held farthest from the eye will more than hide the moon, even at the horizon. Yet no one thinks of comparing fair Luna to so small an object as the tip of their smallest digit.

It follows from all these facts that our judgment of the size of objects depends very much upon the allowance we unconsciously make for distance. The hunter anxiously looking for game may vainly fire away at a supposed animal, but, failing to bring him down, may find that a minute brown insect hanging by its web in front of his eye, but supposed to be at a distance, was mistaken for a much larger animal, and led to a vain expenditure of ammunition. This simple principle is well illustrated when exhibiting the planets to unaccustomed observers through the telescope. I have often, when exhibiting Jupiter with a power that would magnify it to twice the moon's diameter, therefore to four times its size, inquired of the observer, "How large does it appear to you? As large as the moon?" "Oh no, not half! Why about the size of a half-crown." Then I would say, "Open your other eye to take in more of the heavens, and remember you are not looking into the telescope, but through it at the sky;" and they would instantly be convinced that it appeared much larger than the full moon.

I was once walking along a street with which I was well acquainted, and saw upon one of the neighbouring heights a building with a cupola of large cylindrical form that I had never noticed before, although I had often seen, as I

supposed, every structure in that neighbourhood. Looking more carefully, and changing my position a little, the supposed cupola instantly shrunk into an electric street lamp with its metal protecting cylinder, which the supposition of distance had magnified into a large cupola. But to return to our muttons: the moon when in the horizon is seen to be beyond the houses, the trees, and even the huge mountains, and, we unconsciously allowing for her great distance, she swells out to an immensely greater size than when seen high in the heavens, where we have no such convincing proof of her distance. If these views are correct, the phenomenon is a subjective and not an objective one, or, to put it in more elegant Greek, it is all in your eye.

GIANT TORTOISES.

There is a good deal that is weird about the Galapagos Islands, which are situated in the Pacific, near the equator. The islands are sixteen in number—five big and eleven small ones, without counting ever so many little islets—and the line of the equator runs directly through the group. Nevertheless, the climate is not very hot, owing to the remarkable low temperature of the surrounding waters. Once upon a time these islands were volcanic peaks, uplifted from a portion of the continent, which has sunk beneath the ocean, just leaving their tops projecting.

Darwin, when he visited them, found forty-nine species of animals there which were unknown to any other part of the world. Within recent years many domesticated creatures have been introduced by ships and have run wild. Thus at present there are wild cattle, horses, and goats on the islands; likewise wild asses, which have acquired a remarkable habit of sitting up like rabbits, on their haunches. There are wild dogs in droves, as well as flocks of chickens at large; and on Charles and Chatham Islands thousands of cats, every one of them entirely black, live in crevices of lava near the coast, and get a living by hunting for crabs and fishes. The group lies 600 miles west from Ecuador, to which it belongs. Some of the volcanoes were in eruption as late as fifty years ago.

The most remarkable creatures found on the islands are the giant land tortoises, for which they are famous. Presumably, before the submergence of that part of the continent, they were all of one species, but after that happened a colony of them was left on each peak which remained out of water. From these situations of vantage they surveyed the surrounding floods with Noachian philophosy. Being unable to swim, they could not make their way from island to island, and so each isolated community bred by itself and developed distinct characteristics corresponding to its environment. As a result, each island has to-day its own peculiar kind of great turtles. It is surprising how circumstances alter animals. The savages of the Amazon region fed the common green parrot for generations with the fat of certain fishes, thus causing it to become beautifully variegated with red and yellow feathers. In like manner, the natives of the Malay Archipelago, by a process of feeding, change the talkative lory into the gorgeous king lory. These Galapagos tortoises are the only survivors of an ancient race of huge turtles which lived so long ago as the early part of the tertiary epoch. Specimens weighing from 600 to 700 pounds have been captured, and there is authentic record of one individual taken which tipped the scale at 870 pounds. However, nearly all of the very big ones have been caught and devoured, and it will not be long before the race is exterminated—literally "eaten off the face of the earth by gluttonous man." It is reckoned that 10,000,000 of these turtles have been taken from the islands since their discovery.

No provisions for ships were ever found equal to these tortoises, which will remain in good condition for a year, without food or water. A supply of the latter is carried by the animals in a bag which contains as much as two gallons sometimes. They are very sagacious, and, when kept on deck, can be taught to confine themselves to any place arranged for their accommodation by whipping them gently with a rope's end when they go out of it. The meat is said to be finer than that of the green turtle. Dampier, the explorer, who visited the islands in 1634, wrote that the flesh resembled a pullet's egg in flavour. "The oil," he says, "we kept in jars, and used it instead of butter to eat with dumplins." Rogers, in 1707, wrote: "The eggs of the turtles are as big as those of a goose, white with hard shells, and exactly round. Two men rode on the back of one of the creatures, which weighed 700 pounds, and it carried them with ease." In 1793 Colnet reported that the nests of the tortoises were thrown up in circular form, never containing more than three eggs, which are heated by the sun, a hole being so contrived as to admit its rays through its daily course." This last very remarkable statement would seem to imply that these chelonians were somewhat familiar with astronomy.

The tortoises are vegetable feeders, browsing chiefly upon a succulent cactus. It is said that they are entirely deaf, so that even the report of a gun does not startle or alarm them. At intervals they make pilgrimages to the hill-tops, where water is to be found, travelling by night only. Thus, in the course of centuries, they have worn regular roads from the shore up the mountain-sides, by following which the Spaniards first discovered the watering-places. They have very long snake-like necks and heads, and their feet surprisingly resemble those of an elephant. Their clumsy method of locomotion also suggests a likeness to the great pachyderm. Undoubtedly they live to a very great age, and their aspect is most venerable.

Unluckily for them, their esculent qualities have been appreciated from the time when the islands first afforded a landing-place for vessels. Towards the end of the seventeenth century the Galapagos group was a favourite rendezvous for pirates, who were very fond of turtle meat. During after years, whalers used to go thither for the purpose of provisioning their vessels with tortoises, carrying them away by thousands. In 1829 a penal colony was established on Charles Island, which depended largely for food upon turtle flesh. Finally a factory was established for making tortoise oil, which produced 3,000 gallons a year. Reckoning that each good-sized animal yielded one gallon, it will be seen that this signified great slaughter. Besides, the wild dogs have destroyed great numbers, their favourite method being to wait quietly for the eggs to hatch, thereupon devouring the young ones.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.

Or through any Newsagent.

SOCIAL SCIENCE.

REFORM AND REFORMERS.

There is nothing easier in this world than fault-finding. The opportunities for that sort of effort are illimitable, because perfection is practically an unknown quantity. All of the arrangements by which society is maintained and operated are more or less defective, and the ordinary observer can easily see the weak places. One need not be an expert to detect the crudities and inconsistencies, the compromises and makeshifts, of our system of civilisation. They are perceptible to the untrained eye, and can readily be pointed out by any man of average intelligence. We know very well that we have not evolved a flawless plan of life. It bristles with objectionable features, and we tolerate them for reasons of expedience and necessity. They are offensive to us in theory, but the circumstances are such that we cannot help ourselves. We are at the mercy of conditions that baulk our good endeavours and mock our boasted wisdom. The possibilities of improvement depend upon influences that are subject to constant embarrassment and modification. We are forced to make concessions to prejudice and superstition, to ignorance and selfishness; and so it comes that the cause of truth, justice. and morality does not prosper in a satisfactory measure.

The professional reformers spend most of their time in telling us of the existence of certain wrongs and misfortunes. They never tire of specifying the evils that ought to be removed and the errors that ought to be rectified. But that is as far as they go. They do not inform us how we can accomplish these desirable objects; they add nothing to our stock of useful knowledge. It is simply fault-finding. We are reminded of things that we are familiar with by daily experience, and that we would gladly change if somebody would show us the way. There is no advantage in having disagreeable facts repeated to us, unless we are at the same time enlightened as to the means by which we can control and adjust them. The evidences of mistake and disappointment in the general state of affairs are glaring and abundant, but the practical suggestions for the solution of prevailing problems are few and inadequate. We have stacks of books devoted to the enumeration of social and industrial drawbacks, but they are provokingly silent upon the subject of remedies, as if fate could be trusted to provide the latter as fast as the former are presented. The crusaders wander to and fro through the land with messages of a kind that cannot benefit us in the least, owing to their want of rational and suitable advice concerning the treatment of the ills which they describe.

It is not demanded of the reformers that they shall instruct us how to overcome all the obstructions to perfect prosperity and happiness, and substitute a millennial situation for the present one; but it is fair to insist that they shall not consider their task finished when they have merely furnished a catalogue of current disorders. They should be able to recommend processes of relief in some cases, at least, whereas they usually leave that aspect of the matter undiscussed. We are expected to thank and bless them for declaring that we are exposed to grave perils, which they cannot tell us how to meet in a safe and successful manner. That kind of teaching involves a degree of irony that would be amusing if it were not so exasperating. The cheapest of all talk is that which industriously elaborates the sins of the period, and yet fails to indicate any effective method for the promotion of virtue. It is no answer to say that the public attention must first be focused upon the sources of evil, and the public conscience aroused with regard to the impending danger. This is a necessary service, to be sure, but it is only of a preliminary character, and it does not count where there is a lack of definite plans for reaching substantial and salutary ends. No wrong was ever righted by denunciation alone. It is when indignation takes the form of a well-devised movement for a change in the interest of honesty and propriety that it becomes truly effective. The reformers waste their energy when they apply it entirely to the work of stating what ought to be done. It is their duty to demonstrate the feasibility of their proposed reforms by setting forth the means that can be used to inaugurate them, and to repel the assaults that may be made upon them.

The men who really bring reforms to pass are those who supplement their zeal with discretion and patience. They understand human nature and realise the importance of humouring its impulses and predilections. Their judgment is not warped by bigotry and egotism. They are not fanatics, that is to say, and do not render themselves obnoxious by talking in an exaggerated and scattering style. Their manner is mild and persuasive, not tempestuous and intimidating. They are politic in speech and action. If they encounter defeat where they have anticipated triumph, they do not fly into a passion and heap abuse upon all who are opposed to them; they study the lessons of their failure and profit by them in the next attempt. The blunders of to-day bring them wisdom for to-morrow. They do not squander any of their strength in hysterical protests and complaints. It is a part of their philosophy to accept things as they come, and to preserve their serenity and hopefulness under all circumstances. They practice strategy and take advantage of every incident that can be utilised for the promotion of their purposes. Their vigilance is sleepless, their perseverance never flags. They present a bold front when that seems best, and they stoop to conquer when that is necessary.

Those who suppose that the inherent virtue of a given cause is sufficient to insure its success are sadly mistaken. History shows that truth does not prevail by sheer force of its own excellence. It must be sagaciously and skilfully supported, or it will be beaten by adverse and sinister influences. The instances of that sort of failure are frequent and significant. We have conclusive testimony to the effect that a doctrine or undertaking may be perfectly right in the abstract, and yet not command popular approval. There are many hindrances in every case of proposed reform. Account must be taken of the various customs and precedents that largely control the proceedings of the masses. A new truth, or an old truth in a new form, does not make a quick impression. It is regarded with distrust by a majority of the people, because it is strange to them, and they are afraid that it may prove to be false and pernicious. They are slow to favour any change in the existing order of things when it implies a risk of disappointment. It is not enough to give them plausible reasons for expecting a gain in the matter; they must be convinced beyond any chance of doubt that the gain will ensue at a certain time and in a certain way. If they cannot be thus assured they prefer to leave things as they are, and to get along according to rules and expedients that they have tried and found equal to ordinary tests of usefulness.

A distinguished essayist speaks of a certain class of reformers whose goodness is "rather a pardonable weakness than a praiseworthy virtue." We have such persons in plenty nowadays, and it is sometimes difficult to regard them with a tolerant eye, considering how little they do to justify their claims of devotion to the welfare of mankind. They mean well, it may be granted, but their intentions never come

to anything. The agitation that they produce is of no benefit to anybody, for the simple reason that it does not lead to any definite result. Their industry in the dissemination of novel views is more of a detriment than an advantage, because it creates confusion where there would otherwise be a clear and useful understanding of given questions. They are not satisfied with a moderate and considerate presentation of their vagaries, but insist upon monopolising far more than their share of time, and thus making themselves a public burden. Their recognised sincerity serves to excuse them to a certain extent, but it does not authorise them to talk incessantly and to prevent the candid and profitable discussion of topics of practical importance. They take liberties to which they are not entitled by any rule of justice or courtesy. The mostthat can be said for them is that they are apparently unconscious of their own folly ; and that is not a sufficient warant for the flood of loose speech that they inflict upon the country.

These fluent advocates of all sorts of chimerical propositions generally misconstrue their personal experiences as proofs of a general condition. "If anything ail a man," says Thoreau, "so that he does not perform his functions, if he have a pain in his bowels even, for that is the seat of sympathy, he forthwith sets about reforming—the world. Being a microcosm himself, he discovers that the world has been eating green apples ; to his eyes, in fact, the globe itself is a great green apple, which there is danger awful to think of that the children of men will nibble before it is ripe." We have all seen the reformer who draws his inspiration from his abdomen. He is constantly delivering learned lectures upon the laws of life, and publishing dreary treatises upon the alleged mistakes in our system of civilisation. His melancholy views are contrary to all of our observations and at variance with the records of our steady progress in every respect ; but that is immaterial to him. He feels the pain in his own viscera, and cannot be made to believe that he alone has eaten the green apple The drastic philosophy that he teaches may be adapted to his individual case, but the chances are a thousand to one that it is not applicable to anybody else. He magnifies a small fact to absurd dimensions, and flatters himself that he has evolved a great new truth, and invented a wonderful process of redemption from a universal evil.

Such men are never willing to entertain the suggestion that they may be worrying themselves and others about things that do not exist outside of their own thoughts and fancies. They are absolutely sure as to every point that they present. You cannot persuade them to yield a hair's-breadth in deference to your opinions. They scorn the idea that they can be mistaken in any of their assertions or calculations. Their self-conceit is immeasurable and irrepressible. If you venture to wonder how they acquired a knowledge that is entirely free from possibility of error, they simply smile and go on with their oracular talking. Yet they do not convince you that they are right. Your intelligence easily discerns the sophistry in their statements and the misconception in their theories. They sometimes point out a wrong in a plain and correct way, but they do no more. They never prescribe a remedy. This fashion of thinking begins and ends with preliminaries. They do not reach the root of anything. It follows, therefore, that their service is virtually valueless in every case where there is a call for the practical treatment of a question. They can speak all day in a narrow circle, and when they stop they are right where they were when they started. The task of devising means to cure the ills that they denounce and deplore is left for others who are not so self-conceited, but who recognise the necessity of managing movements of reform in a common-sense way. In short, we have plenty who are ready to dimolish our castles, but few who are able to reconstruct them.

HOW OLD IS MAN?

That was a highly convenient and satisfactory belief which we inherited in childhood and held without question for many years regarding the age of the world—meaning thereby both the earth and the human race; for we had originally no other idea than that man and the habitable globe came into being within at most a few days of each other. It was, in fact, only a plain sum in simple addition, which the very smallest arithmeticians could soon handle; 4,004 years, or something like that, from the creation to the Christian era, and then, if you were living, say in the year 1855, you had only to add that number to the other, and there you were. For purposes of broad comparison or rhetorical allusion, we used to speak of the world, and of man inclusive, as being six thousand years old. It seemed a little loose and inaccurate, when the exact figure was perhaps 5,859 ; but something must be pardoned to the greater convenience of round numbers, and to the seductive vice of fluent generalisation. Most of us, doubtless, can remember the shock we experienced on learning for the first time that the question was not whether 6,000 years was one or two hundred above or below the fact, but whether 6,000 or 600,000 was nearer the mark. Yet to this conviction, or rather to this painful want of conviction, have we come at last. As for the age of the planet itself, we presume geologists do not expect to agree, further than to unite in the conclusion that it is of extreme and unknown antiquity. But the disposition has been to deal more hardly with man, and at any rate to confine his utmost "claim of long descent" to something less than ten thousand years. Mr. Flinders Petrie is said to have found a temple in Egypt not long ago, apparently built by one Snefru or Seneferoo, founder of the fourth dynasty, and fully believed to be not less than 6,900 years old. But there is an annoying uncertainty about the age of this fourth dynasty, the estimates ranging from 4,300 up to 6,100 years, and this, in turn, reflects doubt upon the alleged antiquity of the temple. To accomplish anything in this line of historical research, you must first assume something and stick to it ; for whether you reason from the temple to the dynasty or from the dynasty to the temple does not make a particle of difference if each hangs upon the other and neither has any support except upon the clouds of conjecture. It is like having the single equation $x = 2y$, from which to find the respective values of x and y. Give us the official figures for either one and we shall not be long in finding the other.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

Chemical Fire Extinguishers.

W. Cooper.—Chemical fire extinguishers depend for success on the rapid production of carbonic acid gas, which is readily absorbed by water. Carbonic acid gas is easily formed by the mixture of an alkali and an acid. Carbonate of soda, dissolved in ordinary water, will combine with sulphuric acid to produce carbouic acid gas. In Germany a cardboard case is used, contaiuing saltpetre, sulphur, etc. This, when kindled, produces a vapour capable of checking a fire in a closed space. In ordinary chemical fire engines the usual quantities are 28lbs. of bicarbonate of soda and 14lbs. suphuric acid to 80 gallons of water. The carbonic acid gas is giveu off, when the sulphuric acid combines with the soda, with a pressure of 140 lbs. to the square iuch.

Frog Spawn—Snails—Colouring Edges of Books.

H. Summons.—Frog spawn is not a usual article of diet. However, likes and dislikes in tastes are matters of custom and inherited instinct, and so you might acquire in time the liking for even frog spawn. Snails are eaten and enjoyed much abroad, and are, undoubtedly, wholesome aud even nutritious. We could hardly advise as to the book without seeing it. The edges of books are generally coloured by screwing the volume upon a lying press and applying the colour with a sponge. Another method is by mixing the colour or colours with size or paste and then throwing the mixture from a brush violently on the edges. Marbling is another process.

The Weight of the Earth.

F. Barker Cooke.—The usual method of ascertaining the mass of the earth is to compare the attraction of gravity between two known masses, and then between one of these masses and the whole earth. The result of the known experiments, including "Cavendish's experiment," show that the mass of the earth is, approximately, 6,000,000,000,000,000,000,000 tons.

Do the Fixed Stars Change their Relative Positions?

L. Barrett.—The idea suggested to astronomers from observations made, is that the earth is a globe suspended, as it were, within the star sphere. There is an apparent motion of this so-called star sphere, as may be observed by watching the heavens night after night. Relatively to the earth, this star sphere rotates from east to west once in 24 sidereal hours, and this rotation, apparent or real, takes place without any appreciable change in the relative position of the fixed stars. The anuual motion of the earth produces an annual parallax of the stars, but it is very difficult to measure even with the most refined instruments, owing to the erroneous distances of these bodies. The nearest fixed star is 20 billions of miles distant, and it takes light, travelling from it at the rate of 186 millions of miles per second, nearly 3½ years to reach the earth. The whole subject is somewhat long and complicated and not easy to condeuse in a short reply, therefore we should advise a study of astronomy, beginning with the science primer on astronomy, written by Norman Lockyer, and then passing on to Sir Robert Ball's "Story of the Heaveus," an admirable work beautifully illustrated, and interestingly and exhaustively writteu.

Mineral Springs.

H. Kemp.—We are unable to say exactly in what colony the greatest number of mineral springs are to be found or their number. The geological condition of a district is the best guide. Mineral springs are found in all parts of the globe, but more especially in volcanic regions. They are not found, as a rule, in very flat countries or in the deltas of rivers. New Zealand and Canada are rich in mineral springs. In fewer numbers they are found in the West Indies. Little is known of their occurrence in Africa or Australia.

Electricity Applied to Tricycle.

H. T. C.—Electricity has been applied to tricycles, but more as a matter of experiment than of serving a practical end; inasmuch as the storage battery is so heavy and takes up so much room, that the help the electricity gives the machine does not compensate the rider for the extra weight. No doubt never-beaten experimenters in time will overcome this difficulty, and we shall have a tricycle ride helped by electricity. Should this ever become general, we shall have feeding stations placed here and there along the haunts of the cyclists, where a fresh storage of electrical energy can be taken aboard. Unless, however, this exercise can be indulged in with moderation and with an improvement in the position of the rider—especially the safety riders—a re-actiou will set in against it, to save the rising generation from becoming a thick-legged, narrow-chested, round-shouldered race of beings. "Electricity up to Date," by John B. Verity, will tell you of the science generally; and how to construct a motor and dynamo: Bottone "On the construction of a Dynamo."

Chemical Secrets.

Bonnyrigg.—We kuow of no chemicals such as you require. It appears to us that such chemical secrets would mean large fortunes to the happy and fortunate discoverer. And such a discoverer would probably be worldly wise, or, if not he, then some other individual or company, cunning in the ways of modern commerce, would get to know the secret cheaply, and by patenting it get therefrom a large return, while the great world looks on ignorantly. Next week we will give you a few suggestions on knowledge.

Ignorance and Others.—No space now or for other letters which are held over.

Walter S. S. Griffiths & Co., Ltd.,

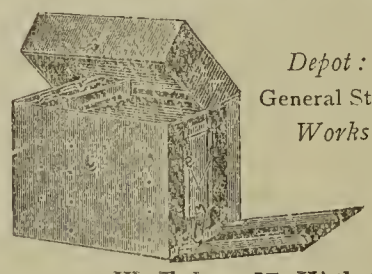
Manufacturers of the Patent

GUINEA

DETECTIVE CAMERAS,

Lantern Slide, Enlargement, & other Cameras.

List post free on application.



Depot: **5, Union Passage, Birmingham.**

General Stores of Photographic Materials and Apparatus

Works: **Highgate Square, Birmingham.**

London Show Rooms and Agency:
The Fry Manufacturing Co.,
5, Chandos Street, Strand.

Wholesale Provincial Agent:
W. Tylar, 57, High Street, Aston, Birmingham.

Edwards' Isochromatic Plates and Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. Dallmeyer "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, 25, NEWMAN STREET, LONDON, W.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.* 3 *months,* 1*s.* 9*d.*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
" Sale and Exchange " Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

LONDON : SATURDAY, MAY 21, 1892.

SCIENCE NEWS AND NOTES.

" That experience teaches fools is not true, for a man that profits by his experience is a wise one. Wiser still is he who profits by the experience of others. The fool nether profits by his own experience nor that of others."—ARCHBISHOP WHATELY.

The Utility of Salt

to the human economy is absolutely denied by a correspondent, Mr. J. P. Munro. This gentleman is a vegetarian, although he admits milk, butter, and eggs into his dietary, because "these articles are not organised animal structures, therefore they contain no impurities." Mr. Munro thinks that it is the duty of scientific literature to contradict the fallacy respecting the evil effects of abstinence from salt. His arguments are very ingenious, but we regret we cannot uphold them. We believe that with training, and much privation during the experiment, man can accustom himself to live on food in any form as long as albumen is present in sufficient quantities. There are even faddists in America who have trained themselves to live on nuts, and it cannot be said that they suffer in any respect by so doing. But man has been a flesh eater from the earliest times, and after countless generations, we cannot do otherwise than suppose it is the form of food best suited to his constitution. Savages who live on roots and herbs are usually of inferior physique; the reverse spectacle is presented by those living by the chase. We may then take it for granted that the constitution of man has, after so many thousands of years, adapted itself to a flesh diet, although experience has also taught us that this should be well mixed with the products of the vegetable kingdom.

Organic Food,

however, contains much débris that cannot be assimilated by the human system. This, of course, also applies to vegetable food. It is in the disposal of this débris that salt, an inorganic substance, is found of such great utility as an aliment. In the stomach it becomes muriatic acid, and in effect aids the digestion, by separating the nutritious matter from that which the system rejects as of no use. Digestion is thus assisted. Even instinct has taught this fact to animals. It is not surprising, therefore, that man's reason should have shown him the value of salt as a food solvent. It has, however, other uses when consumed which we do not purpose entering into here. Dogs, we may mention, are never so healthy as when they consume their food off the earth instead of off a plate or such like, because they thus obtain a certain amount of earthy salts. From the earliest days salt has held the highest place in the esteem of man as an article of food. The creatures of the Saurian period hunted out salt springs with eagerness, and primitive man did the same. The Romans esteemed it as a potent medicine, and a pinch of salt was believed to ward off danger and disease. Hence their habit of advising friends to take a false statement *cum grano salis*—that is, the salt will cure the lie and keep the listener from relying or acting upon it.

The Dietic Value of Bread

has just been dealt with by Mr. James Goodfellow, F.R.M.S. He considers that the people of England have been in a particularly bad state of health owing to the unsatisfactory way bread has hitherto been made. He expresses the belief that bakers, guided by a sound knowledge of certain particulars (that is, regarding hygienic requirements and the food value of bread), will do more than all the theoretical food reformers in England to help the people back to perfect health. Mr. Goodfellow makes some very sensible remarks concerning the value and use of whole-meal bread, as well as on adulterations and impurities in ordinary bread. Having made, as he states, an exhaustive series of examinations, he is entitled to speak with some confidence and authority on the latter subjects. Of the samples of bread examined by him in London, 333 out of 341 were pure, and only three were adulterated with alum. In the provinces, of 194 samples examined, 189 were pure, and only two contained alum. His indictment against impure bread hardly seems to be justified by the sum of his evidence.

The Physiology of Labour

has been defined in an interesting fashion through some experiments conducted by Pettenkofer and Voit, in which they attempted to ascertain the amount of work a healthy labourer could accomplish without injury to health. They constructed a chamber in glass which was hermetically closed. Inside they placed a wheel to which was attached a chain. By turning the wheel the chain raised a weight of 25 kilogrammes. A healthy vigorous labourer was put inside this glass room; and, deducting the time required for meals, he was made to turn the wheel for nine hours a day. This was considered equivalent to hard physical work. The workman was carefully weighed before and after the experiment, the food supplied to him was likewise weighed and analysed. Very great care was taken to make this glass room absolutely air tight. No air could get in or out excepting through the air inlet and the air outlet. Thus it was possible to analyse the air as it went in and as it came out. Pettenkofer was therefore able to ascertain that during the nine hours' work the labourer had expended in the form of carbonic acid 192 grammes of oxygen more than he had been able to inhale during that time. To cover

this deficit, it was calculated that the workman must have expended twenty per cent. of the provision of oxygen stored in his system. Of course this deficit was, to some extent, compensated by the night's repose; but, nevertheless, the balance was not re-established. During the night he naturally absorbed more oxygen than he utilised. But as the respiratory organs work more slowly at night the process of recuperation was not sufficiently prolonged.

A Night's Rest was Insufficient

to re-establish the normal condition after a day of very fatiguing toil, was the conclusion both Pettenkofer and Voit came to. They were of opinion that the deficit might be equal to ten per cent., and in some cases twenty per cent., of the total stock of energy, and this in spite of the restorative effect of a good night's rest. It was the Sunday rest that alone could enable the body to take up the oxygen lost during the week's toil. These experiments, though extremely interesting and suggestive, must only be taken as an approximate indication of the effects of hard work. Where the atmosphere is vitiated by gas, poisonous dust, insufficient ventilation, the results must be much worse than those found in the sort of model existence led by the workman who was imprisoned in a glass room by Professor Pettenkofer. On the other hand, perhaps the workman in the glass room did more muscular work than others who toil in unwholesome factories or workshops. What can, however, be said without fear of contradiction, is, says the *Lancet*, that there is a distinct limit to the human power of physical endurance, and that this limit can be exceeded in nine hours' work, though performed by a thoroughly healthy worker. Therefore, Pettenkofer's experiments would lead us to conclude that eight hours' *hard muscular* work is quite as much as may be safely undertaken even by the strong and healthy.

The Physiology of Dreams

was the subject of a paper read a few days since, before the Royal Institution, by Dr. B. W. Richardson. The lecture, although so prepared as not to be wanting in general interest, was exclusively an exposition of the phenomena and causes of dreams from the scientific side alone. There is no mystery in dreaming, it was contended, that is not already explainable on physical grounds or that does not admit of being explained as investigations on purely physical methods of progress. The phenomena of dreams were first discussed, and were classified under three heads. There are dreams which are entirely objective, brought about by the effect or effects of some external object of action; an external vibration acting upon the corporeal vibratorium. There are subjective dreams, dependent on some vibration occurring within the body itself, and carried by nervous conduction to the sensorium. And there are, thirdly, dreams due to a combination of the objective and subjective influences.

The Different Kinds of Dreams

were defined by Dr. Richardson from particulars which he, from his long experience in professional life, had noted down; and many details of a most interesting character were thus supplied. The dreams of fever, of indigestion, of exhaustion, of pain, of melancholy, of fear, of contention, of motion, of narcotism from inhaling different gases and vapours, and of circumstantial reasoning in sleep, were noticed and exemplified, the evidence in each case being to the effect that an external or internal influence was sustaining by vibration the condition of dream, and that such condition differed only from the waking dream in that it was less perfect and complete. The lecturer dealt with causes of dreams, in which he maintained that the dream is a purely physical phase of life; that it depends on two conditions, our own corporeal organisation, and the state, for a time, of the surroundings of our life. There is no more of mystery, of potency, of prescience, in the dream of sleep than there is in the dream of the wakeful day. We dream according to our nature, our habit, and our environment. Dream is a partial mental activity combined with a more or less complete physical repose.

Mr. Tesla,

in his interesting lecture recently delivered before the British Institution, affirmed that it is quite possible that electromotors may be operated by conduction through rarified air at considerable distances. "Alternate currents," said Mr. Tesla, "especially of high frequencies, pass with astonishing freedom through even slightly rarified gases. The upper strata of the air are rarified. To reach a number of miles out into space requires the overcoming of difficulties of a merely mechanical nature. There is no doubt that, with the enormous potentials obtainable by the use of high frequencies and oil insulation, luminous discharges might be passed through many miles of rarified air, and that, by thus directing the energy of many hundreds or thousands of horse-power, motors or lamps might be operated at considerable distances from stationary sources. But such schemes are mentioned merely as possibilities. We shall have no need to transmit power in this way," and thank goodness, we add, that there will be no such necessity. That difficulties would be experienced in putting such a scheme into practice, Mr. Tesla admits. But they would be "merely mechanical"! The remark indicates, to say the least of it, a very sanguine frame of mind.

Electrocution

originated in America, as far as practical purposes are concerned, and now we learn, that our trans-Atlantic cousins, determined to be at the fore in all things, have invented the "Electrospanker." In the midst of all these bewildering uses to which electricity has been put, it is pleasing to be able to go back to Franklin, who was the first to show that lightning and electricity were one, and see that he fully realised what an important place the new power was destined to occupy in the world. It was he who first suggested the use of electricity as a destroying agent, though he was far too humane a man to offer it as a substitute for the hangman. As might have been expected, it was in a domestic way that the good doctor made his suggestion. As far back as 1752 he said he believed that if turkeys were killed by electricity the meat would be more tender. In these days when so many fowls are scalded alive or allowed to bleed to death, is there no humanitarian ready to come forth to test the practicability of this idea of the father of electricity.

The Sea Serpent

has been made the special study of Dr. A. C. Oudemans, Director of the Zoological Gardens at the Hague, and he is about to issue a book in which he will present his conclusions. Dr. Oudemans has placed side by side "all the accounts, tales, and reports of this great unknown animal," and has convinced himself that "through all the reports there runs only *one* red thread, that there must be *one* single animal species that has given rise to *all* the reports." The author has chosen to write in English, because it is a

language "known to all navigators, as well as to all zoologists, and other men of education." The full title of the work will be "The Great Sea-Serpent. An Historical and Critical Treatise. With the Reports of 166 Appearances, the Suppositions and Suggestions of Scientific and non-Scientific Persons, and the Author's Conclusions."

The Cause of Death by Hanging

has been treated very lucidly by Mr. A. S. Ignatorski in the *St. Petersburger Medicinische Wochenschrift*. He refers the rapid loss of consciousness after suspension to the retarded or arrested circulation in the brain brought about by the increased intra-cranial blood pressure. The effect of this impediment to the circulation is the same as in cerebral anæmia, for in both the nutrition of the brain suffers. It is therefore, not as Leofman teaches, an insufficient supply of blood to the brain, due to compression of the carotids, which interferes with the functional activity of the brain, but compression of the capilliaries by increase of the intra-cranial pressure, which has this effect. and which occurs whilst the supply of food remains the same, or even increases.

Tidings of Auroras

are coming to hand from all directions. The fact that we dealt with the subject in our "Science Queries and Answers" last week has brought us a shoal of correspondence on the subject. Our limited space precludes our dealing with this as we should like, but our correspondents must accept our thanks, and the assurance that their communications were both welcome and interesting.

One of the Mysteries of Modern Science

is the connection between such phenomena and the presence of exuberant sun-spots and other indications of solar activity. That there is such a connection cannot be doubted, Sir Robert Ball tells us, even though we may have only very imperfect notions of the cause. This much is certain, that whenever there is a big disturbance in the sun, as evinced by unusual sun-spots, these auroras and terrestrial phenomena of allied character seem to be invariably witnessed. Professor Langley says that though sun-spots may not stand in any intelligible relation to the weather, as has been often supposed, yet they might conceivably exercise an important influence in terrestrial affairs. We can easily imagine that consequences of much moment might be the result of the failure of a telegram. Such an accident might be caused by an undue development of earth-currents arising from some freak in the earth's magnetism, and this might be attributed to an outbreak on the sun, of which the outward and visible sign is the crop of spots on the bright surface. Hence it may very conceivably happen that sun spots and human affairs could sometimes stand in very direct connection. One of the strangest facts about the sun spots is that they recur with some considerable approach to regularity. They have been watched for three centuries, and every eleven years it appears that a great outbreak may be expected. This periodicity is a striking fact, of which, perhaps, we may find an illustration in the facts so well known about geysers. These wonderful hot springs burst out periodically at intervals of a certain number of hours. These eruptions on a small scale may in some respects be likened, Sir Robert Ball thinks, to what happens every eleven years on a vast scale in the sun.

An Ingenious Theory

to account for the aurora borealis, but one which, however, we must not be taken to support, is advanced by Mr. W. Jamieson, of Greenock. He tells us he has carefully examined and experimented on this subject, and has come to the following conclusions:—The air is composed (roughly speaking) of 21 parts of oxygen and 79 of nitrogen, that is four (*sic.*) times as much nitrogen as oxygen. Mathematically, air should exist through all space, but practically we may say there is a complete vacuum at a height of 500 miles. At this height there will still be four times as much nitrogen as oxygen in the attenuated air. This "thin" air acts as a Geissler tube and the brilliant appearance of the aurora is caused exactly in the same manner as the display in a Geissler tube, moreover the aurora *shows the spectrum of nitrogen*. But where does the electricity come from? Let us assume the earth a magnet revolving before another magnet, the sun. As in all magnets the central portion will be neutral and the poles active, so that the poles attract a magnetic needle while the equatorial regions have no effect on it. What little energy is wasted in revolving the earth is changed into electricity, positive and negative, while the influence of the sun turns the terrestrial system into a dynamo on a grand scale. The currents passing in a circular direction from the poles, through the "thin" atmosphere, and back through the earth produce the effects known as aurora borealis and earth currents respectively. This occurs at all times, and affects all magnetic instruments to a constant degree, but when, from causes at present unknown, the sun exerts abnormal influence, abnormal variations of instruments result. When the magnetic axis of the earth revolves nearly at right angles to the plane of the earth's annual revolution the effect is greatest, *i.e.*, at the equinoxes.

Our Article on Ants

which appears in another column may be supplemented by the following fact told by Mr. W. F. Liesching, writing in the new number of the Selborne Society's Magazine (Ceylon). He saw one day a string of ants streaming forth, evidently in search of "pastures new." He flicked away the leader, and waited to see the result. An immediate halt was made by the foremost ants, and a scene of the utmost confusion ensued. The ants from behind kept arriving from the scene of the catastrophe, and there was soon a black crowd of ants huddling and jostling one another. Some detached themselves from the main group and took a turn round, trying to find traces of their leader. At last the tail end of the line arrived, and after brief consultation they all started off again, and a line soon began to unravel itself from the tangled mass moving back to the hole from which the whole company had so lately started on "pleasure bound or labour all intent." While Mr. Liesching was watching the return journey, a leech stung his leg. He took the creature off and put it down in the line of march. Ants will carry off a worm, why not a leech? It was, however, most amusing to see how carefully all avoided the leech.

It is thought that the absence of limbs is a great disadvantage to snakes, but the fact is that their ribs take the place of limbs, so that, instead of having two pairs, they sometimes have over two hundred. Aristotle thought they had as many ribs as there are days in the month, but, in fact, the number varies, and reaches four hundred in pythons. The movements of the snake's ribs have been likened to those of a caterpillar's legs. Each vertebra supports a pair of ribs which act like a pair of legs having the extremities connected together by a broad plate; the hind part of this plate is free, and when the ribs are moved forward, this end is raised so that it takes hold of any roughness or irregularity of the ground.

GLEANINGS OF THE GLOBE.

In the prehistoric days Egypt was a wooded country.

Sound travels at the rate of 15 miles a minute.

The vibrations of musical strings vary from 32 to 15,000 in a second.

The oak tree enlarges its circumference from 10½ inches to 12 inches every year.

The cost of a one-man sea diving apparatus for a depth of 200 feet is £115.

The seeds of all plants and fruit are indigestible owing to their being encased in a hard covering upon which the gastric juice of animals takes no effect.

Although flint is so indestructible that the strongest chemical aid is required for its solution, plants possess the power of readily dissolving and secreting it.

Out of 1,000 parts of blood in the human body, 779 are water, 141 are red globules, 69 are albumen, 3 are fibrin, 2 are fatty matter, 6 are various salts.

Messrs. J. Lancaster and Son, whose reputation as makers of photographic apparatus, is no doubt well known to our readers, have just issued their catalogue for 1892 (price 4d.). It is a most comprehensive catalogue, and one of the handsomest we have seen.

The planets Mercury and Venus possess a temperature which would melt our solid rocks, while Uranus and Neptune receive so small an amount of heat that water such as ours would become as solid as the hardest rock and our atmosphere would be dissolved into a liquid.

An appeal has been entered against a legal decision in America, on the ground that the defendant who was prevented by illness from appearing in Court, was examined by means of a telephone, the decision of the judges being conveyed to him by the same channel.

The distance of the electric discharge in a thunderstorm may be readily calculated approximately by counting the number of beats of the pulse between the flash and the peal of thunder at the rate of six beats to the mile for persons under 20 years of age, and 5 beats to the mile for persons between 20 and 40 years of age.

The veterinary surgeon has called in electricity to his aid in order to establish the state of a horse's foot. One pole of a battery is placed in contact with the inside hoof, the other in contact with the iron shoe. If the hoof has been pierced with a nail to the quick, the horse will feel the electric current and become irritated ; in the other case, the current cannot pass through the foot.

A magnificent illustration of "Egyptian Science" is now to be seen at Niagara Hall, Westminster. The City of Memphis, as it was visible in the days of the Israelites, is to be viewed in all its pristine splendour. The beauty of the scene is indescribable, and the accuracy of this wonderful restoration reflects the greatest credit on both the artist and the organisers of this interesting cyclorama.

Few botanical facts are better authenticated or can be more easily confirmed by observation than that the convolvulus, trefoil, pimpernel, wood sorrel, and a host of other wild or garden flowers close or half close before rain, and open in anticipation of sunshine ; and the explanation offered is that of the effect of the greater or less intensity of light, or of the electrical condition of the atmosphere, on the petals or leaves of the plant.

The principal differenee between cow's milk and human milk lies in the proportions of the protein constituents, the albumen preponderating in the latter and the casein in the former. A German patent has been recently obtained for rectifying this divergenee by adding to cow's milk albumen in such a condition as not to be readily coagulated. This is effected by heating albumen from vegetable or animal sources to a temperature of 150 deg. C., whereby it is liquefied, and does not coagulate on standing.

Many German engineers prefer masonry to iron for bridges, and they have revived the practice of building masonry bridges with lead joints at the key and points of ruptnre near the spring lines. The Romans used sheets of lead between cut stones, and in bridges built in England in 1833 bands of lead were placed in the joints for two-thirds of the distance above the spring line. The use of lead is for maintaining the proper interval of joint and for uniformly distributing the pressures.

The London Botanical Field Class will resume its annua series of excursions for the study of plant life in the field on May 21st. So many people learn botany from books alone that any attempt to bring them in contact with nature should be welcomed. "A well-guided country walk," says Ruskin, "is worth a hundred lectures." The director is Professor Boulger, F.L.S., F.G.S., the late president of the Essex Field Club, and the hon. sec. is the editor of the *Educational Review*, 2, Creed Lane, E.C.

Some years ago, a theory, founded on considerable observation, was propounded, that ants did not sleep. The published statement of the result of the observations excited considerable remark, for if it is true, ants are the only exceptions known in the animal world to the general rule that sleep is a necessary consequent labour. Further investigation, however, has shown that the experiments made were not suffieiently extensive to justify the conclusion. Ants live through the winter in a dormant or torpid eondition and the fact that they are sometimes seen running about in moonlight is not sufficient evidence that they do not sleep.

Many members of the lower order of creation are far stronger in comparison to their size and weight than the strongest of the human raee. A large black beetle weighing a quarter of an ounce will seramble off easily with a weight of 1½ pounds on its back, which is about the same as for a man to carry a load of coal with the horses and wagon. A grasshopper has been known to jump 200 or 300 times its own length, while a man to accomplish the same proportional feat would have to start from our offices and alight somewhere near Charing-cross-road. The engineering of ants in building their tunnels and constructing their galleries is of so marvellous a character, when compared with the size of the insects, that the Mount Cenis and Gothard tunnels dwindle into insignifieance when compared with the works of these tiny insects.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 29.

97.—Is the pole star absolutely fixed in space over the North Pole?

The apparent motion of the stars (due to the real motion of rotation of the earth) are in celestial circles, becoming smaller and smaller as they are executed nearer to the "pole." The poles of the heavens are marked, of course, by an imaginary prolongation of the earth's axis, and since it happens that the northern pole star is at an angular distance of about $1\frac{1}{2}°$ from the point of no motion, it follows that this star must travel daily through a circle whose diameter subtends an angle of 3°. This motion is imperceptible to the unaided sight, but it can easily be measured by instrumental means. There is, however, another apparent motion not only of the pole star but of the celestial pole itself; and this is performed so slowly as to baffle all but the most delicate processes of measurement. It is due to the precession of the earth's axis—a phenomenon resembling the slow circular movement of the upper pole of a common spinning top. But the circular movement of the poles of the earth's axis is so slow that a complete revolution is only effected once in 25,867 years. Owing to this precession the northern prolongation of the polar line is now approaching nearer to the present pole star. By and bye this motion of approach will become one of recession. That which we now call the pole star will become less and less deserving of the name, and, after a period of 12,000 years or so, its useful office will have been usurped by Vega. To give a still clearer idea of the rate of precessional motion, it may be added that 4,000 years ago the celestial pole must have been situated near to the star Alpha, in the constellation of the Dragon. Of course, there may be proper motions among the stars themselves disturbing these relations; and, indeed, it is very difficult to imagine that any of them can be without such proper motion. But, on the other hand, the distances from us of the stars are so immense that the effects of their proper motions may, for practical purposes, be neglected.

98.—In what way is it easiest to distinguish a boiled from an unboiled egg without breaking the shell?

The simplest method is to spin the egg on its side on a smooth table. When the contents are solid the rotation continues for a considerable length of time. But when the contents are liquid they are only partially set in rotation, the momentum acquired is less, and the spinning egg, retarded by internal friction, will sooner come to rest. A modification of the experiment is to set the egg in rotation and immediately stop it by a firm but momentary touch with the finger. If the contents are liquid they will not at once cease to rotate, and, in fact, before coming to rest they will communicate a new motion of rotation to the egg shell.

99.—What is the best method of preserving botanical specimens?

The plants when first gathered should be inclosed between the leaves of a leather portfolio. At the first convenient opportunity they may be placed between sheets of blotting paper soaked in methylated spirit, and clasped together between two sheets of cardboard by a pair of elastic bands. So long as the evaporation of the spirit is prevented, the plants will remain soft and in perfectly good condition, and thus they may be preserved for years in close tin boxes. When it is desired to press them for the herbarium, sheets of good grey blotting paper should be used—at least half-a-dozen thicknesses upon each side of the plant, and some of the sheets of blotting paper should be cut away in places so that the stems and leaves may be subjected to an even pressure. After pressing between boards for twenty-four hours the blotting paper should be changed, and this should be done daily until the plants have become perfectly dry.

100.—How large are the molecules of matter supposed to be?

A cubic inch of any gas at the ordinary pressure and temperature is supposed to contain about 3×10^{20} detached particles oa molecules, absolutely equal and similar to one another. In solid matter the grained structure corresponds to about 5×10^{8} molecules in the linear inch. As the diameter of the earth is very approximately 5×10^{8} inches, it follows that by magnifying a cubic inch of solid matter to a cube with sides equal to the diameter of the earth, the constituent molecules would be separated from one another by the average distance of one inch. Professor Tait considers that the molecules themselves do not occupy more than about five per cent. of the total volume filled by "solid" matter, whence it follows that the diameters of these molecules must be about one inch $\div 10^{10}$.

101.—In what way is the total heat radiated by the sun arrived at?

A calorimeter filled with a known weight of water, and having one of its faces painted with lampblack, in order to render it absorptive of radiant heat, is exposed to sunshine when the sun is at the zenith in a clear sky. By this means the number of calories of heat received per minute per square foot of surface is determined (a calory is the quantity of heat required to raise one pound of water through one degree centigrade). The quantity of heat absorbed by the earth's atmosphere must, of course, be allowed for:—It is about 25 per cent. of the total obtained by the method just described. Having found in this way the total heat received by the earth, it is necessary to multiply it by 2,300,000,000, this being the denominator of a fraction representing the proportion of the surface of a sphere, whose radius is equal to that of the earth's orbit, that would be covered by a circle of 8,000 miles diameter. The result is that the number of units of heat radiated by the sun per year is found to be 6×10^{30}.

102.—Do not the bones become weaker with age in human beings? If so, to what extent?

Wertheim has found that the breaking weight of bone is about 1,503,000 grammes per square centimetre in a man of thirty years of age, and about 432,500 only in a man of 74.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

109.—Why does the sun appear to lose its circular form as it approaches the horizon?

110.—Is it a fact that steam engines will run more or less steadily, according to how they are placed, with respect to the points of the compass?

111.—How does the use of oil prevent heavy seas from breaking over a ship?

112.—What scientific explanation is there for the phenomenon vulgarly known as "the sun drawing water"?

113.—What is the simplest method of regulating a clock when no astronomical or other instruments are available?

114.—How is the power of a burning glass estimated?

TREES FOR THE STREETS.

Beautiful trees are a delight to the eye, and all trees are a comfort and a physical gratification in the hot summer days. For the sake of their beauty as ministering to a refined taste and a love of nature, for the comfort they afford by protecting a wayfarer in the streets from the fierce rays of the summer sun, it is desirable that we should establish a system for the planting, cultivation, and protecting of trees such as now exists in some other great cities.

Aside from these two reasons that relate to the streets there are other good ones in favour of encouraging the growth of trees in the city, not only in the streets, but everywhere, and one good reason is that trees are among the most efficient of nature's sanitary forces. Every leaf of a healthy tree is an individual purifier of the atmosphere—and a purifier of the kind most needed in the city air. All our enormous contrivances for the drainage of houses to free us from solid and fluid filth are not more useful in their way than trees may be, because these actively take from the atmosphere, when this help is most needed, the noxious elements that are a contamination and a danger.

But in order to have trees in a city it is not sufficient to plant them. Without care and cultivation they will not live, or they live only to become public nuisances. In the country nature takes care of them, but the surface of the earth is not there carefully protected from the rain by impervious pavements, nor is the foliage roasted by the vast addition that reflection from stone walls makes to the solar heat. Trees have a hard time to live if left to themselves in this city and we often see that when they live they are not always lovely. With proper care trees will thrive easily in cities, but the care must be regular and properly maintained through all seasons, and this constant care can only be secured by the organisation of a regular service. In a paved city trees must be regularly watered, because the earth is without the stored-up moisture that serves between rains in other places; they must be tended by experts in respect to pruning, and they must be sedulously guarded against the ravages of all sorts of insect parasites.

Care of this sort makes the city of Paris a paradise as to the beauty and amplitude of the shade it enjoys in great streets that would otherwise be arid wastes of stone. In Paris this is all cared for by a branch of the city government. It is an important municipal function always well performed. We perhaps cannot do it that way. But there is one thing we can always do. We can organise a society for any conceivable purpose. And if a society for the protection of children and another for the protection of animals are good things, why may we not have a society for the propagation, culture, and protection of trees in the city streets,

Here is a chance for city improvement and philanthropy to go hand in hand. If some of our public-spirited citizens would organise a society for this purpose no doubt the Legislature would consent to give it any needed authority.

THE EARTH A SHELL WITH FLUID FILLING.

Just why the magnetic needle, instead of pointing due northward, inclines to one side to a greater or less degree, and why the region towards which it is directed keeps shifting slowly, is a problem which has for ages baffled the wisest men. But a solution of it which, if it is not accepted by the scientific world as complete and final, at least has much to commend it to instant favour, is now offered by Mr. Henry Wilde, F.R.S. It is briefly discussed in an American meteorological paper by that new, though already eminent, authority on terrestrial magnetism, Professor Frank H. Bigelow.

Mr. Wilde has come to the conclusion that the outer shell of the earth and the great mass within rotate somewhat independently of each other. The interior portion, still in a liquid condition, he conceives as continuing to revolve about the axis which our planet had in its infancy; that is, one perpendicular to the plane of the ecliptic. Somehow, in the great cataclysm in which the moon was thrown off from the earth, the crust of our globe was, he thinks, skewed over to one side about 23deg.; and this part of our sphere, therefore, revolves about what we call "the geographical pole." The inner mass, like the other planets and the sun, he regards as electro-dynamic: while the shell is electro-magnetic. Furthermore, two causes are supposed to render those portions of the earth's exterior underlying the oceans more highly magnetic than others: the permanent low temperatures at the bottom of the ocean, and the greater amount of iron here included, the crust being thicker under the seas than elsewhere.

For purposes of demonstration Mr. Wilde constructs a machine, consisting of one sphere within another slightly larger one, both converted into magnets by coils of wire encircling them. Upon those portions of the shell which correspond to the oceans he attaches magnetised sheet iron. And by means of proper gearing he makes the inner and outer spheres rotate on axes 23½ degs. apart. Finally, for test purposes, he provides for temporarily fixing a magnetic needle at any point on the surface of globe. With this ingenious apparatus, he declares he can reproduce every known variation of intensity and direction in terrestrial magnetism of which he can find a record: and, what is the history of all parts of the world for the last four centuries, so far as he can learn, it is actually repeated in the minutest details when the inner sphere is made to fall behind the outer one, in their revolution, at the rate of 22½ minutes of an arc annually! That exceedingly well-informed and cautious expert, Dr. Charles A. Schott, of the United States Coast and Geodetic Survey, tells Professor Bigelow that he has records of magnetic variations of which Mr. Wilde is evidently ignorant; and that when these are used as tests, in addition to the vast number of verifications Mr. Wilde has presented, the theory still holds good. The period of time here required for one whole "secular" change is 960 years, which agrees with the values of Sir William Thomson, though differing somewhat from tradition.

The only doubt which will remain in any scientific mind regarding the soundness of Mr. Wilde's explanations, after studying this magnificent demonstration, will probably spring from the notion, now widely entertained by physicists, that the earth is solid to its core. Sir William Thomson has expressed the belief that the whole globe is as rigid as glass, if not as firm as steel. Yet Mr. Wilde declares himself thus confidently:—"From the various movements of the declination and inclination needles, correlated with each other in direction, time, and amount, on different parts of the earth's surface, the theory of a fluid interior may now be considered to be as firmly established as the doctrine of the diurnal rotation of the earth on its axis."

SHOULD WOMEN BE EDUCATED?

By Sir James Crichton-Brown, M.D., LL.D., F.R.S.

When that eccentric father of a family of geniuses; the late Rev. Mr. Brontë, desiring that his children should speak freely and without timidity, put them behind a mask and questioned them on various subjects, he was told by his son Branwell, then seven years old, in answer to one of his interrogations, that the best way of knowing the difference between the intellects of men and women is by considering the differences between them as to their bodies. That deliverence of the precocious boy seemed to his father at the time a wise saying, worthy of being recorded, and I dare say it seems the same to us as medical men to-day; but it is incontestable that there are now large numbers of cultivated persons to whom it must sound as foolishness, and a mere infantile echo of a barbarous prejudice. Their reply to Mr. Brontë's question would be that it is impossible to distinguish between the intellects of men and women, as there is no difference between them. Bodily differences cannot be overlooked; they are still obtrusive and are admitted.

Certain emotional differences are perhaps conceded; but, as regards intellect, we are told that in its pure atmosphere all gross sexual characteristics disappear. The intellect of woman, it is maintained, except in so far as it has been enfeebled by long ages of subjection, is as good as that of man, if not better. And even where this extreme view is not theoretically held, it is often practically acted on, for those who admit that there are certain differences between the male and female intellect still not rarely advocate the coequal and coordinate employment of men and women in all intellectual exercises and pursuits. There is a growing tendency around us to ignore intellectual distinctions between the sexes, to assimilate the education of girls to that of boys, to throw men and women into industrial competition in every walk of life, and to make them compeers in social intercourse and political privileges. And as to my thinking this tendency is unphysiological, and likely, if indulged, to lead to some unfortunate results, I sieze the opportunity to vindicate the wisdom of Master Branwell Brontë, to insist that there are differences between the intellects of men and women, and that these are best understood by a study of the differences in their bodies, and to suggest that forgetfulness of these differences is already doing injury in one department of education—I mean the high school education of girls.

Now, to catalogue in the briefest way the bodily differences between men and women which underlie their intellectual disparities would be to exhaust the time at my disposal. They are universal and intimate, and involve every organ and tissue. They extend from cuticular appendages to the marrow of the bones, from the crown of the head—for, according to Broca, the female cranium is less elevated than that of the male—to the sole of the foot; for, according Delauney, woman has a plantar arch flatter than that of men, which perhaps accounts for her partiality for high heeled boots. I shall not attempt such an extensive anatomical survey. My present purpose will be served by directing your attention to certain sexual differences in one bodily organ—the brain—differences which have been greatly lost sight of, which much require further investigation, but which are of peculiar significance in connection with intellectual manifestations.

And first amongst cerebral differences between the sexes I would refer to mass and weight, qualities with which one almost insensibly associates power and strength. Now, it is a matter of common observation that women have smaller heads than men, and it is a matter of scientific observation that in all peoples and races, without exception, the absolute weight of the entire brain is on the average greater in men than in women, though, of course, individual women do sometimes possess larger and heavier brains than individual men. But it is also a matter of scientific observation that there is a correlation between brain weight and stature, and, laying hold of this fact, the advocates of women's rights and mights have argued that the deficiency in her brain weight when compared with that of man is no more than is to be accounted for by her fewer inches. But this position is quite untenable. The brains of males exceed those of females in weight by 127·68 grammes (or 4·50 ounces) on the average; and after allowing for differences of stature—taking 5 ft. 7 in. as the average male height, and 5 ft. 2 in. as the average female height—there is still an excess of brain. This is a very substantial difference, and if we recollect that the brain of the ant, of the mental powers of which Sir John Lubbock has spoken in such complimentary terms, declaring that they differ from those of man not so much in kind as in degree, is of the size of a pin point, we shall realise that an extra ounce of brain matter within the human cranium may imply an enormous mental difference. But it is certain that the actual difference in brain weight between healthy English men and English women is much more than one ounce.

The smaller size of the female brain is a fundamental sexual distinction, and is not to be accounted for by the hypothesis that environment, educational advances, and habits of life, acting through a long series of generations, have stimulated the growth of the cerebrum in one sex more than in the other, is made clear by the fact that the same differences in brain weight between men and women has been found in savage races. And not only is the male brain heavier than that of the female, but it has a wider range of variation in weight. The very big brains and the very small brains are encountered, just as are geniuses and idiots, giants and dwarfs, more frequently among men than among women.

I have said that an extra ounce of brain matter within the cranium might involve an enormous mental difference. It would do this were it generally and equally distributed, and it would do so in a still more striking manner were it localised in a certain region of the cerebrum; and there are grounds for believing that there is a difference in the balance of parts in the male and female brains respectively, and this difference I adduce as the second sexual distinction between them.

The third brain difference between the sexes to which I would allude is one of convolutial arrangement which cannot yet be accurately defined, but which the examination of a series of photographs of brains of men and women, which have been stripped of their membranes, pretty clearly reveals. The brains of women, like their bodies generally, are, upon the whole, more symmetrical than those of men. Ocular inspection will, I think, bring home to anyone who diligently uses it the superior symmetry of the female brain, due to its comparative poverty in secondary gyri.

And there is still another brain difference between men and women which I must submit to you, and that a very momentous one—namely, vascular supply. And vascular supply is in some degrees a measure of functional activity, the flow of blood to an organ or part having always a relation to its working power. But the region of the brain

which in men is most richly flushed with blood is that which is concerned, we have reason to believe, in volition, cognitions, and ideo-motor processes; while the region which in women is most vascular is that which is mainly concerned in sensory functions, and we thus see that there is a relation between the size of the cerebral arteries, and what observation has taught us as to the intellectual and emotional differences of the sexes.

The structural differences between the male and female brain, which I have briefly referred to, justify the conclusion that they are organs broadly distinguished from each other, and that they have to some extent different kinds of work to do, and an inquiry into the functional relations of each with other viscera of the body, did time permit of it, would strongly confirm this view. All through life the male brain differs from the female in capacities, aptitudes, and powers. Differences early assert themselves. Thackeray has said that little girls make love in the nursery and practice the arts of coquetry on the page boy who brings the coals upstairs; and as for the page boy it is certain that his pugnacious propensities are already fully developed and have brought him into conflict with his brother buttons. And differences are most patent of all in the prime of life when man "for contemplation or for valour formed" by "his fair large front and eye sublime" declares "absolute rule," add when woman, "grace in her steps, heaven in her eye, in every gesture dignity and love," stands conspicuous for "softness and sweet attractive grace." And differences subsist to the last. The aged spinster, left in "maiden meditation fancy free," lavishes her altruistic emotions on cat, poodle, or parrot; and the hoary veteran, fidgety and irascible, concentrates his egotistic attention on his own liver.

And these differences in brain structure and function, which at every stage of existence separate the sexes, have, as I shall presently show, a special patholoigcal, significance at the period when sexual divergence is taking place most rapidly, and when education is being pushed forward with most vigour. Education from first to last can only be safely conducted in the light of cerebral physiology, but unfortunately those charged with the conduct of education too often dispense with that light, or regard it is misleading. It is to point out to you the risks that are run by dispensing with that light at a particularly dark and tortuous part of the educational highway that I am going to notify for warning and guidance some of the perils to health which seem to me to attend the high school education of girls, which is now so popular.

I have no wholesale indictment to bring against high schools for girls. They have done good service to sound education, have widely diffused its benefits, have supplanted second-rate boarding and venture schools which were hotbeds of namby-pambyism, and have opened up to girls inetrests and helpful attainments which were formerly denied them, thus saving some of them from a vapid and weary existence. But, at the same time, it seems to me that these schools have serious drawbacks attending on them, and that their work is apt to involve very grave dangers to health—dangers immediate and prospective—which have not yet been sufficiently appreciated.

Even from an educational point of view, the work done by high schools for girls is not all pure gain. Their eulogists would have us believe that they have led forth great hosts of girls from a wilderness of ignorance and ineptitude into a land flowing with wit and learning. But that is sheer nonsense. What they have done is to conduct them from the unkempt meadows of natural growth into the trim gardens of artificial culture. Excellent are orchids and camelias in their way, but do not let us forget the buttercups and daisies. Before the high school era dawned girls lived and learned and reasoned in a way, and in introducing them to the higher erudition these schools have withdrawn them to a large extent from homely household occupations which were not without their educational value, and have substituted the dogmatic teaching of the hireling for the precept and example of the mother. So much is this the case, and so impossible is it for growing girls exhausted by five or six hours of school work and private study daily to make themselves acquainted with domestic economy, that it seems to me essential that high schools, if they are faithfully to prepare their pupils to become efficient wives and mothers, should add housewifery in all its branches to their present curriculum.

Two years ago I met in the country a high-school girl who was reading Lucretius for her recreation, but she failed lamentably in the task I prescribed for her—that of boiling a potato. Now I am sure much more of the happiness and wholesomeness of life hinges on the boiling of potatoes than on the interpretation of Lucretius and his dark and doubtful sayings. And not only do high schools for girls deprive their pupils to a considerable extent of home-lore and practice in the simple but captivating arts of the kitchen and still-room, but they tend to induce in them sameness and narrowness of intellect. These schools cannot vary or adapt their teaching to individual tastes and talents, but have one keynote for all, and so sacrifice to clearness of utterance many delicate infections and cadences of faculty. They tend to make education mechanical. Then they so absorb the energies of their pupils, and so persuade them of the paramount importance of their school work that these pupils have neither inclination nor strength to travel beyond their compulsory studies. With brains like wrung sponges, and well assured that there is nothing worth knowing beyond the attainments of the sixth form, high school girls rarely leave the grooves in which they find themselves. It will not be denied that home-reared girls read much more widely than do high school girls. "They browse unconfined," to quote Mrs. Gaskell, "on the wholesome pasturage of English literature," while high school girls are stall fed on condensed primers; and the result is that there is often a breezy freshness and interesting diversity about these home-reared girls that contrasts not unfavourably with the dry precision and monotonous uniformity of their more systematically educated sisters.

(To be concluded next week.)

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.
Or from Messrs. W. H. Smith & Son, E. J. Stoneham, and through any Newsagent.

INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. 1, price 1s., post free, 1s. 2d.
Or through any Newsagent.

"SCIENCE SIFTINGS" FREE OF CHARGE.

We want every intelligent individual to know of the existence of "Science Siftings." Our readers can help us in this way by introducing the paper to their friends, or by sending us the addresses of those they know, to whom we shall be happy to mail specimen copies free of charge. Furthermore, we will send

"SCIENCE SIFTINGS" FREE FOR A YEAR

to anyone who will send us three annual subscriptions of 6s. 6d. each, for themselves or friends.

THE END OF THE WORLD.

Ovid says that while Jupiter made the body of the brute to extend horizontally, its face looking upon the ground, he made man to stand erect, his gaze fixed upon the stars. This may have been the original intention, but if, writes Mr. E. P. Jackson, we may trust that most faithful of all mirrors, the daily press, the gaze of the average modern man would be better accommodated by the horizontal than by the erect position of the body. The gems which stud the heavens may be brighter and more numerous than those which lie buried in the ground, but they are not so available as collateral.

Now and then, however, the heavenly bodies assume a negative value which commands the attention of other men than astronomers. Some far-off star explodes, involving its retinue of planets in stupendous ruin. Why may not a similar fate befall our own star, the sun? Then what would become of us and our collateral? The possibility of such a catastrophe invests the sun with a sudden dignity and importance, which the beneficent glory, and unmenacing splendour of ages could not give him. The common eye is momentarily lifted from the ground; even the daily newspaper honours the grand old luminary with a column or two. This is most apt to follow upon an especially active period of spots, with the consequent meteorological disturbances, like that which has recently occurred.

Science has delivered us from the terrors which afflicted the childhood of our race. Comets, those hobgoblins of the skies, and eclipses, those frightful feints of the angry gods, no longer blanch the faces of men. But for every imaginary terror she has banished, science has revealed a real danger. Microbes and bacteria replace the malevolent sprites of the water and the air; and in the spectacle of the actual conflagration of systems, men have forgotten their childish fear of comets and eclipses. The ghosts of the night have gone, but the sword, bullet, and torch, so to speak, of the day have come.

As we have asked, why may not our sun explode, or burst forth suddenly into such overwhelming intensity of radiation that the earth and all her sister-planets shall be shrivelled like insects in a glowing furnace? It would be an insignificant casualty in the universe, the extinguishment of but a single spark in the all-pervading fire.

Change is the law of all physical being. Nothing is immortal but the ultimate atoms, The sun and its planets had a beginning: they must have an end. When will that end come? Not for many æons yet, we hope. But though we all hope to die at a good old age, some of us must die to-morrow. If to-night the astronomer descrys some remote system "into ruin hurled," to-morrow night may see our own sharing the same fate.

This is possible, but not probable. Though death is the destiny of all, monads, men, and worlds alike, as a rule it does not come without ample warning. In the vast majority of cases, it is preceded by unmistakable symptoms. So far has spectroscopic science advanced that it is able to classify stars very much as medical science classifies men, into the "healthy," the "doubtful," and the "dangerous." Our sun, we are rejoiced to learn, is rated among the "healthy." Its eleven-year periods of spots are not the morbid intermittence of fever, but the natural pulsations of its great glowing heart.

Even if its intensity of radiation should rise far above the usual maximum, it would not necessarily be destructive of planetary life. Tyndall has shown by a series of more than a thousand experiments that an extremely slight change in the constitution of the atmosphere would make a very great difference in its heat-absorbing and heat-transmitting power. A little increase in the average amount of watery vapour held in suspension, for instance, would change a tropical to a temperate climate. In its oceans, therefore, the earth has a shield against the fiery darts of her great lord and master. If they should grow too fierce, like a woman she would quench them with *salt water*.

We may, therefore, comtemplate the dangers to which the solar system is exposed with the same calm unconcern with which the man in robust health contemplates his own possible untimely demise.

MECHANICAL ICES.

We have had the pleasure of examining one of the most ingenious machines, on the penny-in-the-slot principle, that has yet been brought forward. The device is due to Messrs. McCulloch and Dickenson, who have contrived, by what we consider to be a triumph of inventive skill, to produce a magazine of slabs of ice cream, that are preserved without risk of deterioration even when the apparatus is exposed for days to the heat of the sun. There is little fear, however, that these appliances will be tested too severely in the way just referred to. For we believe that the delicious ice creams (manufactured by the Horton Ice Cream Company) will sell "like hot cakes" this summer at one penny each. The mechanical arrangements within the ice cream magazine are simplicity itself. But the mechanism is so well and substantially made that derangement is practically impossible.

Prizes for Amateur Photographers.

We include among our readers so many who practise photography, both for pleasure and scientific research, that we have decided to start a series of competitions, which we shall continue through the season if the interest is maintained. The first competition will consist of

Six Prizes.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co. for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A camera for making enlargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a separate coupon, firmly attached thereto.

The last day for sending in photographs, slides, or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet Street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday June 28th, 1892.

THE GOODWIN SANDS.

The tourist who pays a summer visit to Ramsgate and watches with delight the thousands of children crowding the bright yellow sands, or listens to the strains of the bands floating from different parts of the town, can scarcely imagine what this same town is like during a storm in the months of November or December. If he is at all nautical, however, the very shape of the harbour, the outline of the coast, and the long strips of sand lying a few miles out to sea, will be sufficient to give him a hint of what may be expected.

The harbour is enclosed by piers of solid stone masonry, extending about half a mile out, and gradually approaching at their extremities until they appear almost to meet. There is just room, however, for about the largest ship afloat to pass in. At each of these extremeties there is a powerful light.

Half way across the space of the water thus inclosed there is another stone wall inclosing what is known as the inner harbour. Into this ships pass through openings spanned by revolving bridges, and unload their cargoes. In the outer harbour is the lifeboat, floating, all ready for service, and a couple of powerful steam tugs, one of which generally tows it out and stands by it in the storm to render assistance. And from November to March there is never a week, scarcely a day, in which the services of one or both are not required.

In the summer this fine stone esplanade is crowded with gay promenaders, chatting and laughing, and enjoying the fresh sea breezes. In the winter, during a storm, it is a case of hold on, or you will be blown down, and at high tide the water dashes clear over into the harbour.

The town is built on chalk cliffs from 100 to 200 feet in height, descending sheer down to the sands beneath, which are covered by the sea at flood tide. Stand on these cliffs at low water and look about three miles out to sea. There you will notice a long, dark streak, or, rather, series of streaks, extending about a mile and a half. These are the well-known and terrible Goodwin and Galloper Sands. What a veritable death-trap! When the sea gives up its dead, there will be a large muster on the Goodwin Sands. It gives one a strange feeling to get on board of the many pleasure yachts plying between Ramsgate and the Goodwins in summer time, and sail out to the dreadful marine cemetery. There they lie, shining like gold in the summer sun, low down in the water, only rising about a foot above its bridge, and gently lapped by the rippling waves, looking fair and innocent, as many another beautiful thing in nature which yet has sent many to their death. But in the dark nights of winter, with the wild north-easter rushing dead on shore, the rain and sleet blowing in parallel lines and cutting into your flesh like particles of steel, the thunder of the breakers against the tall, white cliffs mingling with the screaming of the blast, one thinks with horror of the fearful array of white, tossing waves which are pouring over those sands. You picture to yourself the rigging coated with ice, the slippery decks, the helm held down by a broken spoke, cutting into the hand like a knife, but which must still be held for dear life, the momentary expectation of the final crash which will send all on board to the bottom without a vestige of hope, and cry, involuntarily, "God help the poor wretches who are near the Goodwins to-night!"

Ramsgate stands, as anyone can see by looking at the map, just round the corner of the south-east angle. Margate stands on the corner preceding it, to the northward, These two places consequently meet in winter time the full brunt of storms from the north-west, east and south-east, the most terrible storms that blow. It is a grand sight to watch the white waves climbing up those tall cliffs to a height of 60 or 100 feet and falling in showers of spray back into the sea. But there is one class of people at Ramsgate who never seem to see any beauty in it, and that is the sailor's wives. There is no braver race of sailors on the English Coast than the Ramsgate men, and no better boatmen, but to attempt to struggle with the elements in a storm on this dangerous coast in time to save life is frequently hopeless.

MAORI VERSION OF THE DELUGE.

According to the tradition in the Nga-i-tahu tribe of Maoris, men had become very numerous, and evil prevailed everywhere. The tribes quarrelled, and wars were frequent. The worship of Tane was neglected, and his doctrines were openly denied. Men utterly refused to believe the teachings of Para-whneua-mea and Tupunui-a-uta respecting the separation of heaven and earth by Tane, and at length cursed these two devout men when they continued their teaching. Then these two teachers were very angry, and got their stone axes and cut down *totara* and other trees, which they dragged together to the source of the River Tohinga (baptism). They bound the timber together with vines of the *pirita* and ropes and made a very wide raft. Then they made incantations, and built a house on the raft, and put much food into it—fern root, kumar (sweet potato), and dogs. Next they repeated their incantations, and prayed that rain might descend in such abundance as would convince men of the power of Tane, and prove the truth of his existence, and the necessity of the ceremonies of worship for life and for peace, and to avert evil and death. Then these teachers—with Tiu-Rete, a female named Waipuna-Nau, and other women—got on the raft. Tiu, who was the priest on the raft, prayed that the rain might descend in great torrents, and when it had so rained for four or five days and nights he repeated his incantations that it might cease, and it ceased.

The raft was lifted by the waters and floated down the river Tohinga. All men and women and children were drowned of those who denied the truth of the doctrines preached by Tane. The legend then gives a detailed account of the wanderings of the raft, and the doings and adventures of its occupants. Once they saw goddesses wandering on the face of the ocean. These came to make a commotion in the sea, that the raft might be destroyed and those on it might perish. The sea was boisterous, but the raft and its occupants were not overwhelmed. When they had floated about for seven moons, Tiu spoke to his companions, and said: "We shall not die; we shall land on the earth." In the eight month the rolling motion of the raft had changed: it now pitched up and down and rolled. Tiu then said that the signs of his staff indicated that the sea was becoming less deep, and he declared that was the month in which they would land on dry earth. They did land at Hawaiki—the place from which the Maoris, according to their traditions, migrated to New Zealand.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

ANTS.

Astronomy has made us all familiar with the conception of the world over our heads. We no longer speculate with Epicurus and Anaxagoras whether the sun may be as large as a quoit, or even as large as Peloponnesus. We are satisfied that the greater and the lesser lights are worlds, some of them greatly exceeding our own in magnitude.

In a little poem of Dante Rossetti's, he describes a mood of violent grief in which, sitting with his head bowed between his knees, he unconsciously eyes the wood spurge growing at his feet, till from those terrible moments he carries away the one trivial fact cut into his brain for all time, that "the wood spurge has a cup of three." In some such mood of troubled thought, flung perhaps full length on the turf, have we not as unconsciously and intently watched a little ant, trudging across our prostrate form, intent upon its glorious polity: a creature to which we, with our great spiritual world of thought and emotion and will, have no existence except as a sudden and inconvenient upheaval of parti-coloured earth to be scaled, of unknown geological formation, but wholly worthless as having no bearing upon the one great end of their life—the care of larvæ.

If we hold that the chief difference between man and the lower animals is that of kind and not of degree—that man is possessed of an intelligent will that appoints its own ends of a conscience that imposes upon him a "categorical imperative," of spiritual faculties that apprehend and worship the invisible—yet we must admit that his lower animal nature, which forms, as it were, the platform of the spiritual, is built up of lower organisms.

If we hold that thought, will, and conscience, though only manifesting themselves through the medium of cerebral protoplasm, are not its properties any more than the invisible earth elements which lie beyond the violet are the property of the medium which, by altering their refrangibility, makes them its own—then the study of the exact nature and properties of the transmitting medium is equally necessary. Indeed, the whole position can only be finally established of defining experimentally the necessary limitation of the medium, and proving the inefficiency of the lower data to account with the higher.

It is these considerations of the wider issues that give such a peculiar interest to the patient observations which have recently been brought to bear upon the habits of the social insects, especially of ants, which, living in communities, present so many of the conditions of human life, and the development of the "tribal self" from these conditions, to which Professor Clifford attributed the genesis of moral sense.

In order to pass in review these interesting observations and bring out their significance, we must go over ground which is doubtless familiar to most of our readers.

The winged ants, which often excite surprise, are simply the virgin queens and the males. They are entirely dependent upon the workers, and are reared in the same nest. September is the month usually selected as the marriage season, and in the early twilight of a warm day the air will be dark with the winged lovers. After the wedding trip the female tears off her wings—partly by pulling, but mostly by contortions of her body—for her life under ground would render wings not only unnecessary, but cumbersome; while the male is not exposed to the danger of being eaten by his cannibal spouse, as among spiders, nor to be set upon and assassinated by infuriated spinsters, as among bees, but drags out a precarious existence for a few days, and then either dies or is devoured by insectivorous insects. There is reason to believe that some females are fertilised before leaving the nest. We have observed flights of the common *Formica rufa*, in which the females flew away solitary and to great distances before they descended. In such cases it is certain that they were fertilised before their flight.

When a fertilised queen starts a colony it proceeds much in this way: When a shaft has been sunk deep enough to insure safety, or a sheltered position secured underneath the trunk of a tree or a stone, the queen in due time deposits her first eggs, which are carefully reared and nourished. The first brood consists wholly of workers, and numbers between twenty-five and forty in some species, but is smaller in others. The mother ant seeks food for herself and her young till the initial brood are matured, when they take up the burden of life, supply the rapidly increasing family with food, as well as the mother ant, enlarge the quarters, share in the necessary duties, and, in short, become the *real* workers of the nest before they are scarcely out of the shell. The mother ant is seldom allowed to peer beyond her dark quarters, and then only in company with her body guard. She is fed and cared for by the workers, and she in turn assists them in the rearing of the young, and has even been known to give her strength for the extension of the formicary grounds. Several queens often exist in one nest, and we have seen workers drag newly fertilised queens into a formicary to enlarge their resources. As needs be, the quantity of eggs laid is very great, for the loss of life in the ranks of the workers is very large; few survive the season of their hatching, although queens have been known to live eight years.

The ant life has four well marked periods: First, the egg; second, the grub or larva; third, the chrysalis or pupa; fourth, the imago, or perfect insect. The eggs are small, ovate, yellowish-white objects, which hatch in about fifteen to thirty days. The larvæ are small legless grubs, quite large at the apex of the abdomen and tapering toward the head. Both eggs and pupa are incessantly watched and tended, licked and fed, and carried to a place of safety in time of danger. The larvæ are ingeniously sorted as regards age and size, and are never mixed. The larvæ period generally extends through a month, although often much longer, and in most species when the larvæ pass into pupæ they spin a cocoon of white or straw colour, looking much like a shining pebble. Other larvæ do not spin a cocoon, but spend the pupal state naked. When they mature they are carefully assisted from their shells by the workers, which also assist in unfolding and smoothing out the legs. The whole life of the formicary centres upon the young, which proves they have reached a degree of civilisation unknown even in some forms of higher life.

It is curious that, notwithstanding the labour of so many excellent observers, and though ants swarm in every field and wood, we should find so much difficulty in the history of these insects, and that so much obscurity should rest upon some of their habits. Some naturalists, after repeated observations, maintain that in no single instance has an isolated female been known to bring her young to maturity. This is in direct contradiction to Lubbock's theory, who repeatedly tried introducing a new fertile queen into another nest of *Lasius flavus*, and always with the result that the workers became very excited and killed her, even though in one case the nest was without a queen. Of the other kinds, he isolated two pairs of *Myrmica ruginodis*, and, though the males died, the queens lived and brought their offspring to perfection; and nearly a year after their captivity, Sir John Lubbock watched the first young workers carrying the larvæ about, thereby proving the accuracy of the statement, with some species at least. In spite of this convincing testimony,

Lepeletier St. Fargeau is of the opinion that the nests originate with a solitary queen, as was first given.

The ants indigenous to some districts, besides feeding on small flies, insects, and caterpillars—the carcases of which they may be seen dragging to their nests—show the greatest avidity for sweet liquids. They are capable of absorbing large quantities, which they disgorge into the mouths of their companions. In winter time, when the ants are nearly torpid and do not require much nourishment, two or three ants told off as foragers are sufficient to provide for the whole nest. We all know how ants keep their herds in the shape of aphides, or ant cows, which supply them with the sweet liquid they exude. We have often observed an ant gently stroking the aphide with its antennæ to coax it to give down its sweet fluid, much in the same way as a dairy maid would induce a cow to give down its milk by a gentle manipulation of its udders. Some species, principally the masons and miners, remove their aphides to plants in the immediate vicinity of their nest, or even introduce them into the ant home.

In the interior of most nests is also found the small blind beetle (*Claviger*) glistening, and of a uniform red, its mouth of so singular a conformation that it is incapable of feeding itself. The ants carefully feed these poor dependent creatures, and in turn lick the sweet liquid which they secrete and exude. These little *Coleoptera* are only found in the nests of some species; when introduced into the nests of others they excite great bewilderment, and, after having been carefully turned over and examined, are killed in a short time as a useless commodity. Another active species of *Coleoptera*, of the family *Staphylini*, is also found in ant nests. Furnished with wings, it does not remain in the nest, but is forced to return thither by the strange incapacity to feed itself. Like the *Claviger*, it repays its kind nurses by the sweet liquid it exudes, and which is retained by a tuft of hair on either side of the abdomen beneath the wings, which the creature lifts in order that the ant may get at its honeyed recompense. Such mutual services between creatures in no way allied is a most curious fact in the animal world.

TO OUR READERS.

A Two-Guinea Portrait Free.

The Proprietors of "Science Siftings" will present a beautiful porcelain portrait, free of any charge whatsoever, to every reader of the paper who forwards three annual subscriptions of 6s. 6d. each, or six bi-annual subscriptions of 3s. 4d. each. These may be canvassed among friends, and a triple object will be served: the friends will be enlightened, "Science Siftings" will be helped onward, and a free portrait secured by the canvasser:

The liberality of this offer will be appreciated when we state that these portraits cannot be procured in the ordinary course of business under two guineas each. They are artistic portraits, beautifully finished by hand, on porcelain panels, measuring the size of this page (10 inches by 8 inches).

Another Offer.

Our object in making this offer is to cause people to talk about "Science Siftings," and thus to promote the circulation. It will be manifest that we lose money by each portrait. This, however, makes people talk about the portraits, and, hence, about the paper. We will, therefore, send to those readers who cannot induce their friends to subscribe to "Science Siftings," a portrait on receipt of 7s. 6d. to cover the cost of the porcelain panel and postage. The portrait will then be free.

Send a good portrait with the order, and the clearer this is, he better the enlarged porcelain portrait will be.

SOCIAL SCIENCE.

THE RIDICULOUS SIDE OF LOVE.

Is it strange that the things most needful to human happiness should be the things least well done in our lives? No, because the things most needful to happiness are the highest things, and these come last in the process of evolution. Thus it is that the care of the affections lags far behind the care of the stomach among men. For men were obliged to eat some thousands of thousands of years before they felt the pressure of an inward necessity of expending affection on someone. Even the civilised man, says Owen Meredith, can spare nearly everything but cooks. In the beginning of mankind—wherever in the far fogs of the past that mysterious era was—man could get along without cooks, but not without eating; but he had small need of loving. Therefore, to this day, immense care is expended on the business and all the machinery which obtain food and money to buy it with, but small care on the affections. If men transacted business with as little reflection as they use in loving, the world would be bankrupt and starved. Nevertheless, the part of the affections in making human happiness has grown enormously, and now holds the chief place in the whole. Hence the importance and effects of love having grown great, but the habit of giving no reflection to it still persisting, the result is much misery, the miscarriage of many lives, and the production of very sad tragedies.

The "falling in love" has been objected to. It is not a "falling," it has been urged. We ought to say: "Rising in love." This is mere sentimentalism in language. "Falling" is a good word to express going into the depths, as to fall into the sea—no bad figure for the deeps of love. Also, "falling" has a sense of calmness in it, as we speak of the wind "falling," meaning that it comes to quiet after a gale—a good meaning for love, according to Wordsworth's lines:

> The gods approve
> A fervent, not ungovernable, love.

Also, we speak of falling asleep in a poetical and wholly agreeable sense. Decidedly, "falling in love" is not a depraved phrase. Yet there was some wisdom in the remark that the subject ought to be treated with a seriousness which is not accorded it. We mean in common conversation, not in poems and story-books. These, with the dramatists and painters, treat love with great dignity very often. But in common social talk it is belittled sadly by a profusion of jokes, grimaces, grins, slighting remarks, and ridicule. This is one of the most curious things in the world, when it is considered. For apart from the reflection that love is the most important element in the conditions of human happiness, what can be more strange than that there should be a general amusement and odd smiles everywhere regarding sentiments which all persons one after another care to feel?

But there are reasons for the slighting and ridiculous manner in which love is mentioned in common chat, reasons which are to the discredit of the passion in its ordinary forms. One of these is the suddenness with which it sometimes conceives of itself as having come into being. Now, no matter how really great a thing is, it affects us queerly to see it pop up full grown in an instant, like a Jack-in-a-box. Indeed, the greater the thing, the more we are confounded by such a whimsical development of it. A Beethoven beheld starting and growing to his vast proportions excites the greatest reverence and sense of majesty. But conceive Beethovens, Angelos, Leonardos, Shakespeares *et id omne genus*, discharged by volcanoes full grown, we should feel an emotion quite the opposite of reverence. So when two persons who never have

seen or heard of each other meet, and forthwith, *presto*, *la grande passion* flames up and reddens the skies, we cannot help looking askance. For it is a confounding sight in itself; and, however we may see others in the thick of it, no one will admit beforehand that anything so saltatory and acrobatic can happen to himself.

Yet certainly nothing is more curious than the suddenness with which the poets and dramatists (who surely ought to know the truth of the matter) make their heroes and heroines fall in love. It can be compared to nothing better than the incontinent plunge of a senseless stone to the bottom of a pond. When one bethinks him of the reasonable risks of love and marriage, the extreme intimacy of it, and the delicate sentiments that belong to that intimacy, it is past all understanding that anyone can embrace it so trippingly. It is all but inconceivable that the human mind is capable of anything but slow motion in such a matter. Yet the poets represent it as being as swift sometimes as the descent of a hurricane, or apparently as easy and assured as a bit of bartering or a literary judgment. For example, in Shakespeare's "As You Like It," Rosalind no sooner sets eyes on Orlando than she loves him with that frankness that when he has thrown the wrestler she says to him, "Sir, you have wrestled well and overthrown more than your enemies," and hesitates not to tell Celia at once how much she desires him for her husband; and Orlando on his part is "overthrown" equally on the spot. Afterward, when Rosalind is in boy's clothing, Phebe falls in love with her so instantly and so manifestly as to attract her attention; and immediately on her departure Phebe indites an offer of marriage, and sends it after the supposed young shepherd. Again, "Twelfth Night" is a simple maze of abrupt love. The Duke is in love with Olivia and declares that when his eyes fell on her,

> That instant was I turned into a hart,
> And my desires, like fell and cruel hounds,
> E'er since pursue me.

Olivia will have none of the Duke; yet when Viola, in boy's attire, is sent on a message to her, she falls in love with the supposed lad instantly, and avows it. Viola, on the other hand, who has served the Duke in boy's clothing but three days, avows to herself equally that she wishes to be his wife. When Sebastian, Viola's brother, is mistaken by Olivia for her beloved lad, he falls in love as suddenly as the others. And finally, when the Duke is convinced that he cannot obtain Olivia, and Viola's sex is declared, he instantly transfers his affections to her with the most complete satisfaction. What can we make of such a web of easy shifts? Do not such representations go far to account for the bantering, joking, insinuations and grins with which love-news or love-talk is greeted in society very often and in family life as well? For if what is meant by such sudden seizure be a thing of the soul, and the deep fountains of life be stirred, an intellectual and spiritual fact, then it is simply ridiculous. No such spiritual experience can gallop over a man in that sprightly fashion.

Such an effectual blow of love on the instant as prostrates or vanquishes the whole man is not noble. It is wise if any such stroke happen to us, or even if a slower but unassured and untested emotion fasten on us, to try it by absence. There was an admirable man who quickly put the ocean between himself and his charmer for a year. When the waves and travels failed to wash or jolt the emotion out of him in that time, he returned, wooed and won the girl; and his life was very rich in domestic success.

> Then fly betimes for only they
> Conquer love that run away.

Not so, we would say; but rather that absence is the best friend of all reality in love, while whoever will not try that edge on his emotions is like to be conquered himself by a mean pretender to the royal purple of love.

It must be confessed that, remarkable as such descriptions as those in "Twelfth Night" are, they are matched in real life. The poets have not invented basely. Witness Constant de Rebecque of whom a biographer of Mme. Recamier writes: "In the two hours' interview that Mme. Recamier had with him she wished to please and succeeded only too well. He left her presence madly in love. Throughout the whole winter he was a victim to this foolish passion." Such emotions may be called indeed a "foolish passion," and will get no more respect nor be any safer from gibes and cracks of wit than any other folly. That it is prodigiously real to its victim makes no difference. The absurdity consists in the fact that he *is* a *victim*, and that his emotions have no real foundation. The effect is just like that of the intense prepossessions of a state of semi-drunkenness, which are very real to the victim, but half-pitiful and half-amusing to the spectators.

But here is the point, that neither drunkenness nor love ought ever to be amusing at all. Whatever vagaries and absurdities either may produce by any form of it, still these should be viewed as a desecration and sacrilege too sad to stir any merriment. The mere fact of drunkenness ought to be so intensely realised as a desecration of a rational creature that no sense of the ludicrous could be aroused by its grimaces, staggers, and delusions; and all abasements of love, of whatever kind, especially these rank, sudden desires which take impiously its name, ought to stir no frivolity or mirth, but be felt only as a mournful degradation of a grand and elevated experience. Therefore, love always should be treated seriously in conversation; and a fine ingenuous frankness should be permissible. All jokes, innuendoes, winks, and such like irreverence regarding love should be banished as unseemly.

THE Eozoon or "dawn of life animalcule" was discovered in 1864, and considered to be the first of created beings which has been preserved in the early rocks.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

"KNOWLEDGE IS POWER": ITS MEANING.

BONNYRIGG.—From all sides is borne in upon us the truth of this very familiar saying. Man, by the developing powers of his mind, which he has acquired through the gathering experience of the ages discovers gradually more of the hidden laws of Nature, and the wisdom of being their master instead of their slave. With a knowledge of these laws and how to obey them he can enjoy all the parts of existence. With an ignorance of these laws he is always being undone: for he is like a man who on a very dark night walks into a stone wall without knowing it to be there, and as the wall is probably harder and stronger than the man's body, he, by an unalterable and eternal law of Nature gets discomforted. Steam, electricity, and all the modern improvements and inventions are the result of man finding out and using the forces of Nature in further-

ance of his power and happiness. As with the physical, so with the moral and spiritual. For the experience of the past proclaims with no uncertain voice that a vicious, selfish, uncontrolled life brings misery and degradation ; and a virtuous and controlled life, happiness and power, and along with this knowledge comes the stronger will, which is the better part. As to the second part of the question, we should doubt if ignorant men and women ever do possess great power. They may appear to you to do so, but you may be sure they possess a knowledge and a power which you have overlooked. A very clever person may lack steady, every-day consistent effort and other essentials to insure success which the inferior in natural ability has made his own. And no honest effort really fails—although to the superficial looker-on it may—for it adds to the depth of moral character, which after all may be the eternal fact that passes not. We quote on our front page "Knowledge is Power" from one of Sir Francis Bacon's essays.

ETHER OF CHEMISTRY AND THE ETHER OF SPACE—THE DIFFERENCE.

W. TURNER.—The ether of chemistry $(C_2H_5)_2O$. Ether sulphuricus is a colourless, inflammable liquid of a specific gravity of 0·723. It has a characteristic odour and is hot and sweetish to the taste. It is obtained by the action of sulphuric acid on alcohol. The vapour united with the oxygen air is highly explosive. Ether is used to produce unconsciousness where desired by a surgeon. It is thought to be less dangerous than chloroform, as it does not lower the heart's action so much. It is imagined that the ether of space is a fluid of infinite tenuity, which pervades all space, extending through the depths of the limitless heavens and around each molecule that makes up the gas, liquid and solid state, wherever these three states of matter exist, so that every atom of Nature, from the remotest to the nearest, is bound round and permeated by this medium. It is along this medium that light, heat, and electricity travel and make themselves known to the consciousness of our brain. It has not been seen or weighed at any time, but every experiment in heat and light demands its existence. "The only way we establish the truth of a principle, where it cannot be proved by a sense experiment, is by trying it in a number of cases, and if it succeeds in explaining the peculiarities of each case, we have strong grounds for believing in its truth : it is a tree that must be tested by its fruit."

HOW TO PRODUCE OXALIC ACID.

HEATH.—Oxalic acid is almost universally diffused throughout the vegetable kingdom. Sugar, starch, and other organic bodies of the fatty series, when boiled with nitric acid, yield oxalic acid as a penultimate product of oxidation. It is also produced by the action of caustic potash with nitric acid upon most organic compounds of natural occurrence. Heat the compound and nitric acid in a flask till its effervescence has ceased, then when this solution is evaporated and cooled the oxalic acid will separate as crystals.

NEW ZEALAND TIME.

REID.—Local time varies proportionately with the longitude, an hour corresponding to 15 deg., the variation of time thus depending upon longitude. Every degree east of Greenwich is four minutes earlier, and every degree west four minutes later. New Zealand is situated 166 deg. 25 min. to 178 deg. 35 min. E. longitude. Therefore, when it is noon at Greenwich on Sunday it is so many minutes (according to the number of degrees of longitude going east) earlier : therefore, it would be 11.39 p.m. Saturday at Auckland, New Zealand. The time, of course, would vary in other parts of the island. You can work out the time which you require from these data.

ELECTRICITY.

CROWLEY.—So far as we know your experiment of charging the copper wire by means of concentrated light is certainly new in electrical science, and would have, we should think, considerable theoretical value. We fancy from the wording of your letter that you are confusing the term magnetism with electricity. Is the state of the copper wire magnetic or electric? By your reference to the attraction of metals, we assume it is the latter. You have, we should imagine, charged the copper wire with static electricity. It is not within our province to advise you as to turning your discovery (*sic*) to commercial purposes.

MISCELLANEOUS.

DAY.—We don't know any way to obliterate nitric acid stains. If the stain is drenched with ammonia, it will save the destruction of the material.

H. P. C.—"Book on Physicial Development," Mr. Geo. Hambleton, care of The Royal Polytechnic, Regent-street, London.

P. M.—135 deg. C. and 200 deg. C. is correct. Your other questions come not within the range of this column.

BROOKE MANSLEY.—Silicate of soda united with ground glass makes an acid-proof cement. White and red lead united and made up with boiled linseed oil might be suitable for your purpose. Asbestos powder united with liquid silicate of soda to form a thick paste will stand acid vapours.

F. PARKER.—We regret we cannot use your M.S. It is very readable, but hardly our style.

W. F. MILLS.—Thanks for your interesting letter. Your knowledge came in very usefully.

FOREST HILL.—Oxalic acid being a poisonous material, we recommend you to employ permanganate of potash. The strength of the solution for disinfectiug purposes is not a matter of great importance ; only the stronger the solution the less of it you need to use. Add sufficient of the crystals to make a deep red liquid, this being the liquid commonly known as "Condy's Fluid."

HY. BREWSET.—Thanks for your suggestion. We will see what can be done.

Walter S. S. Griffiths & Co., Ltd.,

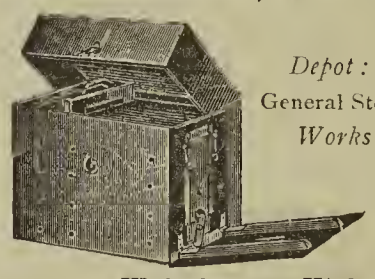
MANUFACTURERS OF THE PATENT

GUINEA

DETECTIVE CAMERAS,

Lantern Slide, Enlargement, & other Cameras.

List post free on application.



Depot : **5, Union Passage, Birmingham.**

General Stores of Photographic Materials and Apparatus

Works : **Highgate Square, Birmingham.**

London Show Rooms and Agency :

The Fry Manufacturing Co., 5, Chandos Street, Strand.

Wholesale Provincial Agent :

W. Tylar, 57, High Street, Aston, Birmingham.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6 ; ½, 3/8 ; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. DALLMEYER "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, 25, NEWMAN STREET, LONDON, W.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.* 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

LONDON: SATURDAY, MAY 28, 1892.

SCIENCE NEWS AND NOTES.

"Beauty of body soon fades and changes, while beauty of mind, disposition, and mentality, increase for ever."
—ANON.

The Overcrowding of Cities

has just induced Dr. G. V. Poore to deliver a very important lecture at University College. The lecture deals with cause, effect and cure. London, for instance, has more than doubled its population in the last half century. The cause of this concentration of population is the desire for business, the wish to get money easily and quickly, and to spend it advantageously. A man who trades in a centre of express mail services, telegraphs, and telephones, has all the world before him if he knows how to make use of it. There is consequently a rush for such favoured centres, and it has come about that steam and electricity, which annihilate time and space, instead of enabling us to live further apart from each other, have produced a directly opposite effect. The dealer, be he wholesale or retail, likes to be surrounded by a crowd of potential customers, rather than be dependent on a few; and the artisan naturally turns to great industrial centres as offering the readiest market for his labour, and often finds out too late that the higher wages of the town are more than counterbalanced by the extra cost of living. The crowds of independent and idle persons who settle in the towns, do so because they find a greater variety of methods of killing time, or as they prefer to put it, because the state of civilisation is greater in the towns than in the country.

The Death-rate

of cities where such concentration of population is to be found, is about 20 per cent. over that of the country districts, although especially in the case of London, the population is largely composed of selected adults imported from the country. It is, however, congratulatory to know that London is not nearly such a death trap as the majority of important cities. In fact, London may be said to form one extreme—the temperate one—and Chicago is the other extreme. This great city—the site of the coming World's Fair—has a zymotic death-rate nearly double that of London; the death-rate from typhoid fever is nearly five times as great as the largest typhoid fever death-rate ever recorded in London. Other complaints appear to carry off their victims at a like rate. In short, London is an elysium of bliss, compared to the diseased, smoky, noisy, ill-paved, over-populated city of which we have recently heard so much. Take it all in all, we Londoners have much to be thankful for.

Modern Invention

is, however, the scapegoat to which Dr. Poore fixes the blame for the troubles of city life. We live, he tells us, thanks to the march of machinery in human warehouses. The craze of the present time is for tenement houses, which are called model dwellings, flats, or mansions, according to the class for which they are intended. Whatever they may be called they are all of the same type, and they are calculated to trouble the soul of the sanitarian who knows the danger of overcrowding on space and under a common roof. Let us hear what other cities can teach on this subject. Edinburgh enjoyed for many years the unenviable notoriety of being subject to periodical outbursts of fever. These assumed in all cases the epidemic form, and entailed a large mortality among the citizens. There can be no doubt that one main cause of these repeated outbreaks was the manner of housing the inhabitants which, copied from the French, consisted in piling tenement above tenement, until a large overcrowded population was confined in a limited space, and could only communicate with the outer world by a narrow stair. When infectious disease of any kind broke out in such circumstances, it spread with great rapidity, and quickly assumed the epidemic form. Tenement houses are common in Paris, where the overcrowding on space as a consequence is on an average twice as great as in London, and where the death-rate is considerably higher than in London.

Another Terror of Life

appears to be butchers' meat. The *Lancet* declares that no idea can be formed of the amount of flesh of animals which have died or been killed because of disease, that finds its way into the market as human food. There can scarcely be a doubt that thousands, perhaps tens of thousands, of cattle sheep, and pigs are bought by the less reputable butcher or the "dropped meat salesman," and prepared by them for consumption, the beasts being at the time of purchase hopelessly ill or already dead. A great traffic must be going on in such flesh, as the carcases are rarely buried, and inquiries at the knackeries tend to prove that they very rarely find their way to these establishments. It is generally the custom for the owners of sick animals to send for the butcher to take them away either dead or alive, and probably after they have received a large quantity of drugs, some of these being, perhaps, of a poisonous description. What becomes of the carcases we can only surmise, but that they are dressed and exposed for sale can scarcely admit of a doubt; indeed it is a moral certainty to which veterinary surgeons and others could testify. Even in the ordinary slaughter-houses diseased animals can often be seen either before or after death, and the fact of their flesh being refused sale is never heard of. The butchers could tell some startling stories with regard

to this matter if they cared to do so ; but everything is kept dark respecting it, and it is only at rare intervals that a chance discovery is made of some carcase that should have been buried, being either found in transit to the meat market or actually exposed for sale on the butcher's stall. The slaughter-houses are private places where anything can be done in the way of dressing up diseased carcases without much fear of detection, either there or afterwards ; and there is only too much reason to apprehend that great cruelty to animals is inflicted at times in such obscure places. The only remedy appears to be the introduction of public abattoirs wherever possible, and, where these cannot be established, the institution of a system of thorough inspection of the private slaughter-houses.

The Question of Female Education,

owing to the excellent paper by Sir James Crichton Brown, the concluding portion of which we publish in another column, is arousing considerable interest just now. Professor Mosso, of Turin, one of the world's leading authorities on the brain, has also just delivered an important lecture on the subject before the Queen of Italy, of which we shall have more to say at some future date. In the meantime we revert to an excellent illustration by our contemporary the *Lancet*, which points irresistably to the conclusion arrived at by the English authority. We take the art of music. There is no room here for the contention that, as compared with the boy, the girl has not had fair play—that opportunities for cultivating the art have in her case been few, in his case many. The reverse is the truth. If there is a branch of education in which girls have been schooled to the neglect of every other, it is precisely that of music. It might have been thought that if practice gives perfection, woman would have excelled her male counterpart, not only as an executant, but as a composer. But what are the facts ? In instrumental performance she cannot for a moment compare with him, while as to composition she is nowhere. The repertory of music, from the dawn of the art to the present day, owes simply nothing to her. Considering the time she has spent over it, her failure to evolve new harmonies or even new melodies is one of the most extraordinary enigmas in the history of the fine arts. Why with such a record of "no results"—so far, at least, as the production of a female Handel or Beethoven, or even a female Glück or Bellini is concerned—music should usurp such a preponderant place in girls' education it is difficult to divine. We must not be understood to advocate the cause of man against woman, or even boy against girl. We have an intense admiration for our fair sisters in their proper sphere—but it must be distinctly remembered that each sex has its sphere. We do not wish to see these spheres interchanged, and the world turned topsy-turvey.

The Best Way to do Brain Work,

may be gleaned from a recent lecture by the authority we referred to in the preceding paragraph, Professor Mosso. He emphasises the importance of keeping the surface and extremities of the body warm during brainwork, and points out that when the brain is active much more blood is sent to it from the peripheral parts of the body. He has also found that the circulation of the blood in the brain is subject to fluctuations which are apparently not dependent on physical activity. Fatigue caused by brainwork, acts as a poison which affects all the organs, especially the muscular system. The blood of dogs fatigued by long racing, also acts as a poison, and when injected into other dogs makes them exhibit all the symptoms of fatigue. Sense of fatigue seems to be due to the products of the nerve cells, rather than to deficiency of proper substance.

The Temperature of the Brain

is also the subject of observation. In profound sleep a noise or other stimulus to the senses will cause a slight development of heat to the brain, but its temperature may fall below that of the blood in the arteries because of the great radiation of heat from the surface of the head. As a rule the temperature of the brain is lower than that of the interior of the body, but intense mental activity or the action of drugs may send it up from 0·2 deg. to 0·3 deg. C. above that of the interior of the body. The mere maintenance of consciousness involves considerable chemical action in the brain, and the variations of temperature due to attention, pain, or other sensations are small. Narcotics and anæsthetics suspend the chemical functions of the nerve cells. In a dog made insensible by anæsthetics there is no longer a rise of temperature on stimulating its brain with electricity, and we are led to suppose that the physical basis of the mental processes is of the nature of chemical action.

A Collection of the Oldest Fishes

in the world has been prepared for exhibition at the Washington National Museum. They were dug out of the rocks recently at Canyon City, Colo. Great scientific interest has been aroused by the discovery, because they are at least 100,000 years more ancient than any creatures with backbones ever found before. They come from the sedimentary deposits laid down by water in the distant epoch called the silurian. No vertebrate animals has been obtained previously below the upper silurian. These are from the lower silurian, and some notion of the difference of time may be got from the fact that the two "horizons" are separated in the Appalachian region by 20,000 feet of sediment. Where these fishes were found was once a sand beach on the western shore of a vast interior sea, which extended eastward from the Rocky Mountains and covered a large part of the continent. Geologists, wandering through that region so prolific of treasures in the shape of fossils, came upon the deposits accidentally. The line of the ancient beach is still visible, although it is overlaid by sedimentary rocks of subsequent formation. They made excavations with pickaxe and dynamite, getting out a great quantity of material, which was brought to Washington. Thirty millions of years have perhaps elasped since the creatures thus dug out were living. It must have been a strange world in which they had their being so far back in the night of time. Even the reptiles which flourished and attained such gigantic dimensions at a later period did not yet exist. The only vertebrates were fishes.

The Lower Silurian

fishes were all small—the diminutive types of the great fishes which swarmed in the waters at a later period, which has been called the Age of Fishes. They were clad in armour, being covered with plates of bone instead of scales. Their skeletons were composed wholly of cartilage, like those of the sharks of to-day, which themselves represent an enormously ancient finny pattern. Under the microscope it is possible to see the structure of the bone which composed the plates. In similar armour was the huge and ferocious dinichthys, as well as other marine monsters of a subsequent epoch, dressed. Besides the fishes many invertebrate animals were found in these same deposits. There were innumerable boring worms, and it is very interesting

to see the holes which they made so long ago in fragments of rock. There were frilobites also—queer crustaceans which were the ancestors of modern lobsters and crabs. Molluscs there were in plenty, too, of a species known as the "lingula," somewhat resembling clams. Millions upon millions of years ago they were good to eat. At the present time the lingulas are very plentiful in Chesapeake Bay. Of these ancient creatures they alone have survived; the others are all extinct. Together with the fossils above described were so many specimens of the orthoceras—a mollusc resembling the chambered nautilus, but having a straight shell instead of a spiral one. Above the deposits which formed the grave of the animals mentioned a coral reef subsequently was built by industrious polyps.

The Carriage of Coal

has been the subject of a novel scheme by Mr. W. C. Andrews, president of the New York Steam Company. At the mines the coal will first be ground to a fine powder and then mixed with a large volume of water, which will then be pumped into pipes by powerful engines, and forced through them at about six or seven miles an hour, which will prevent the coal dust from settling. This liquid, which will have the appearance of ink, but of somewhat thicker consistency, will be deposited in extensive tanks, where the coal dust will settle to the bottom, the sediment being collected and compressed into bricks of various sizes ready for use as fuel. It is stated that work will be commenced on a pipe line of this nature from the Connellsville coal region in Pennsylvania, where a large coal field has been secured by those interested in the scheme, to New York City. The line will be constructed of 15 in. pipe and it is estimated that the discharging capacity at the New York end will be 10,000 tons of coal dust per day. A model of this proposed line on a small scale has been in operation in New York for some time, the pipe extending about two blocks, starting from a station and running back to it again. It is said that the model worked with complete satisfaction and in such a manner as to prove that the scheme is perfectly feasible.

Stealing Electricity

has not yet been adjudged illegal in the United States. We cannot see, however, why there should have been any doubts about the illegality of the act. A hardware dealer of St. Louis with some knowledge of electricity placed a fine wire across the connections to his meter and caused it to register in a certain time about 320 amperes less than was actually used. When brought to trial, his lawyer interposed the ingenious defence that as at common law electricity was unknown, and could not, under the code, be made a subject of larceny, and as no statutory law had been passed making it a felony or misdemeanour to steal electricity, for the reason that its character was not known, and that it was not subject to asportation as personal property, his client could not be convicted of larceny. It was, however, shown by the prosecution that gas, also unknown at common law, was nevertheless something whose larceny was recognised by the law as a misdemeanour. When the attorney for the defence interposed the plea that the Act in question was fraud or deception instead of a larceny, the judge took advantage of the Missouri statute, which makes fraud perpetrated with a view to theft a felony, and set the defendant's bail at 5,000 dols. We should like to hear the conclusion of this case.

A Balloon Voyage

is to be made by Prof. King, the famous aeronaut, who proposes to attempt a voyage across the Atlantic. He will start from Philadelphia in August. If Prof. King should be successful it will be the first time so large a body of water has been crossed in a balloon. All arrangements have not been made as yet, and it is not quite decided that the start will be made this year, but the Professor is well backed by bankers in Philadelphia, and he is very hopeful. Such a trip would cost about £5,000. His idea is that the balloon should carry a drag rope 1,000 or 2,000 feet long, with end trailing in the water. In this way the balloon could strike a current of air and travel with it across the ocean. There would be two cars attached to the balloon. The upper one would carry the passengers and food; the lower one would be used as a cuisine and could be descended into by means of a rope ladder. The idea is to have the cuisine removed from the upper car about the space of twenty feet, so that there would be no danger from the coal oil stove. Prof. King has made over three hundred balloon ascensions.

The Language of the Elephant,

is as well understood by the East Indians and those who have to do with the animal as if the communication were made in their own tongue, though, curious to relate, the sounds in India and Ceylon have different meanings attributed to them. When enraged, an elephant utters a shrill cry through the trunk, which may be taken as a warning. A sportsman engaged in hunting elephants had approached a large tusker, when he found to his chagrin that he had dropped his ammunition, so that he could only lie concealed and feast his eyes upon the huge animal. His disappointment was partly compensated for by observing the elephant informing the herd that danger was lurking near it. Communication was made in the following way:—The tusker was feeding, and moved slowly around until it suddenly came below the concealed sportsman, when with its wonderful scent, it immediately recognised the presence of its enemy. Then it stopped feeding, raised the tip of its trunk cautiously, and, in a low, suppressed, but penetrating tone, uttered with its lips the sound "prut," which it repeated so that it somewhat resembled the twittering of a bird. The sound would hardly have been noticed had not the sportsman been near at hand; but it was immediately understood by the herd, which moved quickly but silently away, followed by the sentinel.

Pleasure is often expressed

by elephants in an excruciating squeak, far from pleasurable to the auditor. When satisfied and contented, the animal purrs gently. Fear finds expression often in a remarkable reverberating roar, and sometimes in a shrill squeak. A thoroughly enraged elephant utters a deep warning sound in the throat, and often a hollow, reverberating, rumbling sound. When suspicious, or desirous of giving a slight warning, the tip of the trunk is tapped upon the ground, while from the trunk there issues a volume of air which at times sounds like a sheet of tin being rolled. Young or baby elephants express their wants by singular sounds uttered by the throat. Another sound made by wild elephants is produced by striking the sides forcibly with the trunk. That elephants use these and other sounds as methods of communication, or as language, there can be no doubt.

GLEANINGS OF THE GLOBE.

A SINGLE sheet of paper six feet wide and seven and three-quarter miles long has been made at a paper-mill in New Jersey (U.S.A.).

IT is strange, though true, that in Asia and Africa, where grass will not grow, the most beautiful flowers and shrubs flourish to perfection.

AN enormous orange tree in America is said to be fifteen feet in circumference and forty feet high. The yield this year is expected to reach 10,000 oranges.

WE learn that the Académie des Sciences will probably nominate Lord Kelvin (Sir William Thomson) as successor to the late Emperor of Brazil as one of the eight foreign associates.

BEFORE the introduction of iron tools the making of a canoe was a work of enormous difficulty. The hatchets used were of stone and the chisels were of mussel shells ground to a sharp edge.

MANY kinds of wasps construct their nests of paper, and they doubtless manufactured this article long before man ever contributed sonnets to the waste-paper basket or filled in a cheque.

THE New South Wales World's Fair (Chicago) Commission is contemplating sending for exhibition copies of the noted aboriginal cave inscriptions of Northern Queensland, and also a whole tribe of aborigines.

IT is the present expectation that every species of fish and other aquatic animal large enough to be seen, which is native to inland waters and to the Atlantic and Pacific oceans, except perhaps a live whale, will be exhibited in the Fisheries Department of the Chicago Exhibition.

M. MESDRAN, of Paris, has invented a machine for the proper boiling of eggs. Hitherto, it seems, mankind has boiled eggs on a wholly false principle. M. Mesdran claims that he has solved the problem, and that his invention is nothing short of "a revelation both from the hygienic and the gastronomic point of view." The invention has been patented in England.

M. HENNOCQUE, who has, perhaps, made more extended spectroscopic studies of the blood than any other pathologist, has recently perfected a new form of hæmatoscope, by means of which he is able to measure with great exactness the amount of oxyhæmoglobin in the blood, when the quantity contained is greater than 0·000,000,81.

ANIMALCULÆ in drinking water are not all killed by the cold weather. An examination by a high-power microscope of a drop of water drawn from the hydrant, even at a temperature almost freezing, will show that there are numerous creatures of different kinds floating about in a state of very aggravating liveliness. Of course they are not numerous, nor do they look so vicious as when the water has been heated by a July temperature, but for all that there are too many of them to make unfiltered water a pleasant drink, especially after one has examined it with a high-power glass.

WINDOW plants may be grown any season of the year in the following manner :—Soak a large piece of coarse sponge in water, squeeze half dry, and sprinkle in the openings red clover seed, millet, barley, grass, rice, and oats. Hang it in the window where the sun shines a portion of the day, and sprinkle daily with water. It will soon form a mass of living green, where even the clover will bloom.

THE discoverer and champion of the *Abrus Precatorius*, or weather plant, an Austrian Professor, Dr. Nowack by name, affirmed that by means of the sensitive movements of its leaves and midribs a change of weather, and the direction from which the change was about to come, could be ascertained 48 hours beforehand. It also correctly foretold the coming of earthquake shocks in 96 cases out of a hundred. The *Abrus Precatorius* was subjected to close observation at Kew Gardens, but, unhappily, the results were not such as to bear out Dr. Nowack's testimonial.

THE ordinary commonplace soap bubble, which is generally looked upon as a mere plaything, is, in the hands of the physicist, not only an exceedingly interesting and instructive illustration of a number of phenomena, but it serves also as a sort of tool or apparatus for experimenting, and as such it apparently stands alone as one of the toughest and most elastic membranes known. That it is tough will doubtless at first appear strange to many because a bubble bursts so readily, but when its exceedingly small thickness is considered in connection with its relatively great tensile strength, it will be found to be well entitled to be called a tough membrane. Among the more recent applications of the soap bubble as a scientific tool in electrical researches are a series of experiments by Professor C. V. Boys.

MILK is a little heavier than water. Its specific gravity varies from 1025 to 1032—water being 1000—a gallon of whole milk weighing from 10·25 to 10·35 lbs. Another fact to note is that the higher the percentage of cream the lower the specific gravity of the whole milk. A high specific gravity in milk indicates low quality, through loss of cream ; for example, the specific gravity of skimmed milk varies from 1028 to 1032. As milk fat—the chief part of cream —is lighter than water, its partial removal from the milk makes the specific gravity of the remaining milk greater, but, by subsequently adding water, the specific gravity may be lowered down to that of the original milk. The specific gravity of milk taken alone is valueless as a test of its quality in any case of adulteration.

WHEN oxide of iron is placed in contact with timber excluded from the atmosphere, and aided by a slightly increased temperature, the oxide will part with its oxygen, and is converted into very finely divided particles of metallic iron having such an affinity for oxygen that, when afterwards exposed to the action of the atmosphere from any cause, oxygen is so rapidly absorbed that these particles become suddenly red hot, and if in sufficient quantity will produce a temperature far beyond the ignition point of dry timber. Wherever iron pipes are employed for the circulation of any heated medium, whether hot water, hot air, or steam, and the pipes are allowed to become rusty, in close contact with timber, it is only necessary to suppose that under these circumstances the particles of metallic iron become exposed to the action of the atmosphere—and this may occur from the mere expansion or contraction of the pipes—in order to account for many of the fires which periodically take place at the commencement of the winter season.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 30.

103.—At what rate is the speed of the rotation of the earth decreasing?

Prof. J. C. Adams, by calculations based upon the theory of tidal evolution, has found that the centennial retardation of the rotary motion of the earth corresponds to a loss of approximately 22 seconds of terrestrial time. That is to say, the yearly loss of time, upon the average, during one hundred years, must amount to one-fifth of a second. And if the retardation of rate giving the integral effect calculated by Prof. Adams be supposed uniform, it follows that the rotational velocity of the earth will be decreasing at the rate of exactly ·22 of a second per year in the middle of the century.

104.—In what different senses is the word horse-power used by engineers?

The English "horse-power" is derived from experiments made by Boulton and Watt with strong dray horses. It is the amount of work done when 33,000 lbs. are raised one foot high in a minute. The actual or brake horse-power of an engine is, therefore, the number of foot pounds exerted at the driving wheel in one minute, divided by 33,000 foot pounds. The indicated horse-power of an engine is the actual amount of work done by the steam in the cylinders. But it is less than the effective or brake horse-power by an amount dependent on the frictions of the several working parts. Indicated horse-power is measured by means of a spring guage, which marks the pressure of the steam upon the piston at every portion of its stroke or travel in the cylinder. Nominal horse-power is a term too vague to be defined here with any approach to completeness. There are twenty different units of nominal horse-power relating to as many different classes of engines and boilers; and since all of these "nominal" units are falling into disuse, very little good would be done by enumerating them. The most accurate way of reckoning the power of a boiler is by the number of pounds or cubic feet of water that it will evaporate in the course of a certain time, say an hour, under the most economical practical conditions. It is easy to calculate the number of horse-power absorbed in the production of a given weight of steam. Knowing the quantity of heat contained in the given amount of steam, we have only to multiply this by 772 and divide by 33,000. Thus, to give a simple example of the relation between heat and work, if ten pounds of water be raised in temperature 1° F. in one minute, this involves the absorption of heat to the amount of ten English units—an amount of energy equivalent to 7,720 foot pounds, *i.e.*, to nearly a quarter of a horse-power exerted during one minute.

105.—What is the astronomical significance of the aberration of light?

The aberration is a case of the resolutions of velocities—the velocity with which the earth is travelling through space, and the longitudinal velocity with which waves of light approach from distant stars. There is also an aberration due to the rotational motion of the earth, but this is of secondary importance. Consider the case of a telescope tube, 20 feet long, and pointed to a star. It might be supposed that since light travels in straight lines, the true direction of this star, with reference, say, to a plumb-line at the earth's surface would always be measured by the inclination of the optical axis of the telescope to the same plumb-line. But, in fact, this is not necessarily the case. The optical axis—the line joining the centre of the telescopic object glass and eyepiece—may not lie in the true direction of the star. For the purpose of explaining this we may assume that the image of the star is formed by a cylinder of parallel "rays" impinging on the object glass of the telescope and refracted in passing through this glass, so as to converge to a point at the distance of, say 20 feet. The waves of light take a certain very minute interval of time to travel this distance in the telescope; and if the motion of the earth relatively to the stars is carrying the instrument in a direction sideways to the line of sight, it follows that even if the cone of converging light rays be exactly concentric with the telescope tube at the point of entrance, and if at that point the axes of the cone and tube exactly coincide, they cannot coincide at the lower end of the tube where the eyepiece is situated; for, in the meantime, during the interval of time above referred to, the axis of the telescope itself has been in motion. To allow for this, the aberration due to the earth's motion through about $\frac{1}{10}$th of an inch, it is necessary to slightly incline the axis of the telescope whenever the star under examination happens to be situated at that point of interstellar space towards which the earth is for the instant travelling. When, as it is said, the star is "at the apex of the earth's way," there is, of course, no aberration; but there is in this case a foreshortening of the light waves, resulting in a slight change of their colour. Since the velocity of light in air is known experimentally, the velocity of the earth's motion can now be calculated by simple proportion. It is to that of light as $\frac{1}{10}$th of an inch is to 20 feet. From this again the distance travelled yearly, or the circumference of the earth's orbit, can be computed, and therefore, the orbital radius, *i.e.*, the distance of the sun.

106.—Is it known, or can it be ascertained, what is the highest altitude at which a man can live, or to which a bird can fly?

Death ensues in animals when the pressure is reduced to one-fifth of an atmosphere. It is due simply to deficiency in oxygen which operates as though in normal circumstances the blood corpuscles were enormously reduced in number. Just as bloodletting may be described as corpuscular deoxygenation, so this is "barometric" deoxygenation of the blood, and the fatal effects of both are precisely similar. The second question has not, so far as I know, been experimented on, but there would be no difficulty in doing so, with the aid of one of Jourdanet's rarifaction cylinders—a vessel of about 3 feet in diameter by 7 feet high, in which the air can be rarified and the temperature can be lowered as desired to conform with atmospheric conditions.

107.—How is the length of the seconds pendulum accurately measured?

Kater's method is generally employed. The pendulum rod is provided with sliding or adjustable weights, and with one fixed and one movable pair of knife edges, both directed towards the middle point of the rod. The pendulum is first swung on the fixed knife edges, and adjusted to beat

seconds. It is next swung on the movable knife edges, and these are adjusted until the same period of vibration is secured. The distance between the knife edges, which can be very accurately measured, is the length of a "simple" seconds pendulum.

108.—By what means can the finest metal wire be made?

By surrounding a cylinder of the metal with a considerable thickness of some very ductile material and then drawing the combined mass. Thus a piece of platinum wire may be fitted in a hole truly bored in a thick cylinder of silver. The silver may then be drawn through draw holes down to the smallest diameter that it is practicable or convenient to employ. The platinum core will thus be reduced to a condition of extreme tenuity, and it can be freed from silver by treatment with nitric acid. An iron core would be freed from the silver by cyanide of potassium, and with other combinations of metals other solvents would be used.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

115.—Why is the new moon crescent-shaped?
116.—How large are the drops of water in clouds?
117.—How far off can ships or other objects be seen at sea?
118.—What is the amount of the centrifugal force due to the earth's rotation?
119.—What will be the ultimate fate of the earth-moon system according to the theory of tidal evolution?
120.—To what purpose is the spectroscope applied in meteorology?

THE EVOLUTION OF INFINITE INVOLUTION.

Man has always sought means to express numbers in a form occupying as little space as possible. The simplest form of writing them is also the bulkiest. Savages express numbers by placing a single straight mark for each unit. If an Indian wished to write of eleven men, he would represent the number thus, IIIIIIIIIII, one mark for every man. He would use but one symbol, and repeat it as often as there are individuals in the collection to be enumerated. By this plan eight figures could represent only eight things.

A step farther was the invention of plural symbols, one symbol standing for each number. Many ancient nations used this plan. By it the Romans could express a million by one symbol, $\bar{\text{M}}$. Eight figures could express no higher number than eight million.

Next, the Arabic system of notation introduced local value increasing in geometrical ratio, and by this plan eight figures can express the number 99,999,999. But man's active mind was not content with even this abbreviated method. True, it expresses with eight figures a number so great that if written out in the old Indian style a piece of paper sixty miles long would be required on which to write it.

But man longed for some shorter method, and so adopted an abbreviated geometrical ratio—a plan by which many similar multiplications could be indicated by one figure, called an exponent. By this plan we abbreviate marvellously. It would take several volumes to write out in Indian notation, one mark for every individual, the number denoted by the two largest digits, one placed as the exponent of the other (9^9). Indeed, by using very large exponents we soon express a number which, when raised to the power indicated, is almost unwritable. Thus $10^{10\,000\,000}$, if expounded, could only be written by the use of tons of paper. The number indicated by 1 with 10,000,000,000 ciphers annexed is so large that it would express not only the number of atoms in the universe, but almost the number of atoms in an infinity of universes. When we regard this fact we readily perceive why man stopped here and sought no more powerful series.

Let us go a little farther and we will find that by a development of the ideas of local value and of increase in geometrical ratio, we reach a form of expression by which we can indicate numbers absolutely unwritable in the ordinary notation. Thus, exponents might be arranged as follows:—$([10^{10}]^{10})^{10}$. This expression is equal to $10^{10\,000}$, or 1 with 1,000 ciphers annexed. The same thing might be indicated thus:—

$$10^{10^{3}} = 10^{10\,000}, \text{ etc.}$$

Affect this secondary exponent itself with an exponent and we reach an expression which indicates what we may call an infinite number. Thus the expression—

$$10^{10^{10^{10}}} = 10^{10^{10\,000\,000\,000}} =$$

—but it is impossible to pursue the series farther; $10^{10\,000\,000\,000}$ would be 1 with 10,000,000,000 ciphers annexed. We cannot numerate this number, but, in order to talk about it, let us assume a name. Call it a *multillion*—a purely arbitrary name.

For the last step in our expansion we would have 10 to the *multillionth* power, or 1 with a *multillion* ciphers annexed. But a *multillion* is a number almost infinitely greater than the number of atoms in the universe. So

$$10^{10^{10^{10}}}$$

is, when expanded, found to be equal to a number so great that to write it in ordinary Arabic notation would require 1 with a number of ciphers annexed almost infinitely greater than the number of atoms in the universe. With eight figures the savage can express the number eight. With the eight figures—

$$10^{10^{10^{10}}}$$

civilised man can express a number so great that even to write it in the wonderfully abbreviated Arabic notation would require an infinity of universes to hold the paper it is written on. Make the symbols a little more numerous—as

$$10^{10^{10^{10}}}$$

—and soon we have a combination of a few simple symbols which indicates a number so vast that it almost surpasses our belief, nor can we credit that any mind can comprehend it in its (from our standpoint) absolute infinitude.

Is there anything in the "Arabian Nights," or Poe, or Jules Verne a quintillionth as wonderful as this dry little bit of mathematics?

A GENTLEMAN in New York has recently tested the result of preserving a turkey in a refrigerator for ten years. This time having elapsed, the fowl was removed from the refrigerator, and, after being properly cooked, was eaten by a party of gentlemen. While putrefactive changes seem to have been entirely absent, it was found that the meat was practically tasteless.

THE SCIENCE OF THE COMPLEXION.

In an interesting paper dealing with "light as a therapeutic agent," we are told by Messrs. A. Barry Blacker, M.D., B.S., and R. H. Clacke, M.A., M.B., that the most interesting of the physiological effects of solar radiation is pigmentation of the skin, which it can scarcely be doubted forms a protection from the sun's rays, and is developed as a consequence of the direct action of light. With few exceptions, which can probably be accounted for by migration and other circumstances, there is a very marked relationship between the pigment present in the skin in various races, and the intensity of the sunlight to which they are habitually exposed. Some cases which appear to be exceptions may not be so in reality. For instance, on the American Continent the aborigines do not possess the black pigment which is found in the tropical races of the Old World, but are mostly yellow or copper coloured. This may be due to their being younger races which have not been subjected to the action of natural selection for such a long period : but there is good evidence to show that pigment is deposited as a protection from the actinic rays of the sun, and that for this object yellow pigment is almost as efficacious as black, and serves a similar purpose, at any rate over a large portion of the globe. Black pigment varies directly with the latitude, and consequently with both sunlight and heat. But so far as temperature is concerned, black pigment in the skin is a distinct disadvantage to it possessor, as it is just in those places where the most deeply pigmented races are found, that the oscillations of day and night temperature make the effect of this pigment most prejudicial.

At first sight this appears to be paradoxical, and so it has often been regarded. Some writers have attempted to escape from the dilemma by asserting that pigment is advantageous even in relation to heat, alleging that if it absorbs more heat it compensates for this by greater radiation, and therefore, that black clothes would afford a better protection from the sun than white ones. Of course this argument is absurd, as is sufficiently demonstrated by the fact that a black body in the sun absorbs heat more quickly than a white one, and cools more rapidly in the shade. Clearly this is disadvantageous to the black man in both directions. There is no physiological function which is more admirable for its power, accuracy, and delicacy of adjustment than the regulation of animal heat. The actual energy expended in maintaining a constant temperature is relatively great compared with that expended in muscular exercise ; but the balance of combustion and evaporation, the rapidity and certainty with which both are constantly available, the great delicacy of the automatic regulator which never allows of more than a variation of one or two degrees under the extremes of temperature to which men are exposed, and the well-known risk to the organism of any deviation beyond these narrow limits, sufficiently attest the importance of the thermotaxic function. There is no reason to suppose that this function is less important to black men than to others, although it is much more severely tested, especially in those who are exposed to the rapid alternations of temperature in the desert and elsewhere.

It must be for some very important object, therefore, that the negro is penalised in this particular respect ; or—to use a common figure—Nature, who has taken such pains to secure a constant bodily temperature, introduces obstacles in its attainment in those cases in which the difficulties are exceptionally great. What the object of the penalty is there can be little doubt. Heat and light are the only attributes of sunshine with which we are acquainted. If pigment places the negro at a disadvantage as regards heat, it must give some advantage as regards light, or he would not have survived. We know that the only effect pigment can have on light is to intercept it, and we must conclude that under certain circumstances this is an important function, and that the purpose of pigment is to protect the body from some injurious effect of light. Many facts support this conclusion : pigmentation of the skin in white races is produced by sunlight without high temperature, as shown by the tanning which follows exposure on glaciers or on the sea in cold bright weather ; moreover, the same conditions produce irritation of the skin, conjunctiva, and retina, expressed by redness, desquamation, eczema, solare, ophthalmia, snow-blindness, etc.

Now, it would seem a fair deduction to arrive at that in these cases light gives rise to irritation of the peripheral (external) nerves ; for how else are these effects produced ? It is certain that pigment, either black or yellow, would protect these peripheral nerves, and that a deposit of such pigment takes place as a result of exposure to light ; and the inference is at least probable that the pigment is deposited in order to protect the peripheral nerves from injury. The effects alluded to are not produced by a high temperature alone, either solar or artificial ; and, on the other hand, the intolerance of light exhibited by albinos, which is very distinct in the albinos of coloured races, and can also be observed in many white animals with pink eyes, the facility with which very fair people tan, the tolerance of light by dark persons, and the survival of black men in places where they are exposed to the most intense sunlight, and of more or less pigmented races in tropical or sub-tropical climates—all these facts agree with the hypothesis advanced ; indeed it would be difficult to account for them by any other.

There is evidence to show that black people visiting this country, deprived by their pigment of some of the light which is rarely too abundant, exhibit depressed vitality and impaired resistance to disease. They feel the cold acutely, and it is stated that negroes in Virginia burn their lower extremities severely by sitting or sleeping too close to the fire in their efforts to keep warm. It may be objected that such observations have nothing to do with light, and are merely questions of temperature and climate. This may be so, but it is worth while weighing all available facts, for though, of course, tropical races feel the cold more acutely than those from higher latitudes, it is possible that want of light may depress their vitality and render them more susceptible. It is worth noting in this connection that during the winter in Egypt the wind is sometimes bitterly cold, whilst the light is shown by photography to be very powerful ; and when this occurs, Europeans may be seen in thick winter clothing, sitting down to meals in great-coats and complaining bitterly, whilst the Arabs remain outside all the day, with legs and arms bare, in thin cotton garments, and do not seem to suffer, though they feel the cold. Certainly they do not show impaired vitality, and the question would naturally suggest itself whether this is due to the stimulus of light. If the tanning of the skin caused by exposure to the sun were due to heat, glass-blowers, casters, founders, etc., would become deeply pigmented ; and it is concluded that the actinic rays have a chemical action which stimulates the peripheral nerves.

It might be supposed that the action of sunlight would be best ascertained by a study of the effects of sun-stroke, and very probably this is the case. But all the writers of large experience we have consulted attribute the results mainly to heat ; and although they describe several varieties of sun-stroke occurring under distinct conditions, but little referen

is made to the possibility of light having exercised an influence in any of them. It is obviously impossible for anyone without considerable practical experience of the subject to draw positive conclusions from descriptions alone, especially when the observations described have not been directed to the point in question. There is also this difficulty, that intense sunlight must always be associated with a fairly high temperature. But though sunlight cannot be altogether separated from heat, it is quite possible to study the effects of heat alone, and some information might be obtained by comparing the effects of a high temperature alone with those produced by heat and light together, and no doubt conditions might be observed in which there was brilliant light with a moderate temperature. It seems probable that some of the cases described of healthy men suddenly struck down while exposed to the sun, with symptoms of general shock, cold skin, asphyxia, convulsions, etc., and later with meningitis or other signs of cerebro-spinal injury, owe their symptoms wholly or in part to the stimulus of excessive light, and that these symptoms may differ from those of a stoker who succumbs in the Red Sea, or from the syncope which may be observed in the overheated room of a Turkish bath.

The most distinct therapeutic (remedial) action is observed in rheumatism, most cases of which improve with the advent of hot weather, but there is no evidence that this in any way due to light. Some of the irritative symptoms, however, occur without a very high temperature, and, on the other hand, they are not often produced by the *Khamsin*, though, when this wind is blowing, the heat is occasionally very oppressive, and gives rise to distinct symptoms. From a comparison of the phenomena enumerated, and other analogies, such as the structure of the retina, neurotic pigmentation, etc., it is almost certain that the nervous system is primarily involved in the action of light. Presumably the peripheral nerves, either directly or through some medium, are stimulated by the actinic rays, and originate impulses which are conveyed to the nerve centres. That such stimuli should be beneficial when moderate, and in excess should give rise to local and general injury, and excite a protective deposit of pigment about the stimulated nerve-ends, is in accordance with what might be anticipated and with what is observed. For instance, electric light gives rise to effects closely resembling those produced by over-exposure to the sun; and though it does follow that its action corresponds with that of sunlight in all degrees of intensity, it is quite possible that when carefully regulated and properly applied, it may possess beneficial qualities, which might be employed independently or as auxiliaries to sunlight. If it has any therapeutic properties, there ought to be no difficulty in utilising them, as something a good deal less intense than the most brilliant light would be sufficient, and would possess the advantage of being always available and easily regulated.

We think the evidence adduced, though not complete, on the whole supports the conclusion that the physical distinction between thermal and actinic rays in sunlight is physiologically important, and may be of therapeutic value. For our purpose it is sufficient to distinguish the factors of sunlight as light and heat. The former, including the chemically active rays, excites the peripheral nerves, and in moderation stimulates nutrition and vitality; in excess it produces various degrees of superficial injury and reflex irritation of other parts, and ultimately involves the nervous centres. The stimulus of the chemical rays of certain intensity causes a deposit of black or yellow pigment in exposed parts as a protection from injurious effects, and this protection must be very important to the organism as considerable penalties are incurred in order to secure it. These considerations suggest that the more or less prolonged application of bright sunlight, and possibly of electric light also, to the whole surface of the body, might with advantage be employed to stimulate the nervous system generally, or possibly for some specific effect in special cases. At any rate it seems worth while to submit the question to the test of experiment, and this could probably be done without any great trouble or expense.

THE EVOLUTION OF THE RAILWAY.

It is most interesting, says Mr. W. Armstrong Willis in the *Gentleman's Magazine*, to trace how tenaciously the first railway managers in England clung to the traditions of coaching. The builders of the first railway carriages made no allowance for the changed mode of progression and motion which was introduced with the steam-engine. They retained the short, narrow, stuffy body of the stage-coach, set it upon four wheels of another make, and then attached it to the engine as to a new, enlarged kind of horse. With the increased speed of travelling the motion became intolerable, and, when a high rate of speed was reached, few people could keep their seats. By degrees, but very slowly, these things were improved. Better ventilation was insured, more wheels were added, and the carriages were enlarged; doors and windows were so constructed as to keep out the clouds of dust that choked the traveller on badly made and ill-kept lines. The same principle of evolution which has turned the old stage-coach into the comfortable saloon-carriage has been at work in every department of railways and their management, and the highly intricate and important system of modern signalling springs from a most simple beginning. Shortly after the opening of the Stockton and Darlington line, which was the earliest line constructed, one of the station-masters is traditionally said to have adopted the simple expedient of putting a lighted candle in the window of the station-house when it was necessary for the train to stop. When the Liverpool and Manchester Railway was first opened, in 1830, the only means of signalling the trains was a flag by day and a lamp by night. The first advance to modern signalling began about four years after the line had been opened, when stout posts were provided upon which lamps were placed by the pointsman. Nowadays the signalman's cabin is the centre from which all signalling radiates.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

WILL BE ON SALE NEXT WEEK

PRICE THREEPENCE.

At all Bookstalls, Newsagents, and Fancy Goods Dealers.

MONEY PRIZES EVERY WEEK FOR CORRECT SOLUTIONS.

Full Particulars in our next issue.

Notice to Newsagents.

We anticipate the demand for this Puzzle will be phenomenal; therefore, Newsagents are recommended to obtain an early supply The Trade may order SCIENCE SIFTINGS Puzzle, through any Wholesale Agent, or direct from the Manufacturer:—

MR. ADOLF HAMBURG, 7, Hatton Garden, E.C.

SHOULD WOMEN BE EDUCATED?

By Sir James Crichton-Brown, M.D., LL.D., F.R.S.

But it is not about the educational advantages or drawbacks of high schools for girls that I wish to speak, but about the dangers to health which lurk in their aims and methods—dangers very real, very serious, very imminent—all arising out of forgetfulness of sexual differentiation, and out of the futile attempt to educate boys and girls on exactly the same lines.

Now, I do not hesitate to affirm that over-pressure is rampant in high schools for girls in this country to-day. Of course there are high schools and high schools. Much depends on the head mistress. If she is judicious and sympathetic, over-pressure is reduced to a minimum. If she is hard and keen, it is raised to a maximum. But, whatever the disposition of the head mistress may be, over-pressure exists and is promoted by directors jealous of the honour of their schools and not averse to dividends; by parents anxious about their daughters' prospects in life, earnest to obtain the best possible return for fees paid, or not unwilling to hide their own dulness under the lustre of having clever children; and by the girls themselves, who, when the spirit of emulation is stirred in them or the fear of failure conjured up, strain eagerly forward and ignore all warnings and restraints. I willingly admit that in high schools for girls generally there is a sincere desire to avoid over-pressure, and that precautionary measures to prevent it are adopted; and I have no doubt that during the last five or six years there has been considerable mitigation of it, as a consequence of a limit put to the scramble after examinations and certificates.

I have no doubt that this statement of mine that over-pressure exists in high schools for girls will be strenuously, perhaps scornfully, denied. These schools have many attractive features, and are doing good work; the girls seen streaming in and out of them look healthy and happy enough, and those who are content to judge by superficial appearances will pronounce them sound to the core. Stethoscopy and endoscopy medically applied are necessary to get at their weak points.

I obtained a few years ago a return which I regard as of great interest, and which throws some light on the matter. It is certainly not a little remarkable to find from it that of 187 girls belonging to the upper and middle classes, well fed and clad and cared for, and ranging from ten to seventeen years of age, as many as 137 complained of headaches, which in sixty-five instances occurred occasionally, in forty-eight frequently, and in twenty-four habitually. Sir Richard Owen once said to me: "Children have no business with headaches at all, and if you find that these occur frequently in any school, you may depend on it there is something wrong there." And so, I take it, there must be something radically wrong in high schools that produce so copious a crop of cephalalgia. That the headaches dealt with in this return were connected with school work is, I think, made probable by the fact that, while in twenty-six cases they are stated to have occurred in the morning, in as many as seventy-six they are set down as of most frequent occurrence in the afternoon and evening, when, as you will notice, according to an immense majority of the girls, the hardest part of the day's work falls on an already jaded brain. And there are other significant facts in this return, besides those relating to headaches, for as many as thirty-seven of the 187 girls were shortsighted, and four of them exhibited choreic movements. And this return represents no exceptional state of things.

Inquiries made quite lately satisfy me that a very large proportion of high school girls still suffer from headache, that neuralgia is common amongst them, and that they display multifarious indications of nervous exhaustion. It is no infrequent occurrence, I am told, for the more delicate girls, who return after the holidays looking tolerably well, to break down in the middle of the term, to be absent from school for a few days or weeks, to return and struggle on with their work, but finally to shirk the examination at the close of the term. But if we had no evidence of suffering or disability immediately resulting from high school training as it is now carried on, we, as medical men, should not hesitate to pronounce that training in some respects pernicious, from a consideration of its character alone. Two-thirds of high school girls will attest that the hardest part of their work—preparation, which involves the opening up of new ground, an advance on what has been already learnt, and effort in surmounting obstacles—has to be performed in the evening, when they are already worn out, at the very time when in the cycle of daily life their brains are least capable of exertion. And no inconsiderable number of high school girls will attest that this arduous work of preparation is often carried on until ten, sometimes even until eleven o'clock at night.

The truth seems to be that the checks imposed upon home work are nominal and not real, and that what high school authorities have to do is largely to reduce it in amount, and in the case of young girls to abolish it altogether. The drudgery of education should be done in school with skilled assistance, when the brain is in its prime vigour, not at home unaided, or with only precarious parental help, when the brain is already fatigued. I feel strongly that no girl from ten to seventeen years of age should have any forced brain work to do after 7 p.m., and that a reduction is required in the number of hours that high school girls are now called on to give to brain work. Our brawny colliers clamour to have their bodily labour restricted to eight hours a day. Shall we permit our fragile girls to engage in mental toil for an even longer shift?

I have given prominence to the question of home work in connection with high school education, because I regard it as one of the chief evils of the system; but in connection with the school work there are several topics that are eminently worthy of medical consideration. A criticism of the curriculum and of the subjects taught cannot be undertaken here; but a word must be said about the competition which is still encouraged in some quarters. Nineteenth century girls at the age of puberty cannot stand competition. It is intellectually and morally injurious to them, and disturbs the equilibrium of health. "Nothing," says Ruskin, "is ever done beautifully which is done in rivalship, nor nobly which is done in pride," and nothing, I would add, is ever done safely by girls which is done in emulation. That should be banished from their education, and marks, places, and prizes tabooed. And examinations, too, which harass and agitate, should be as much as possible avoided. For girls who have to earn their own living examinations may be necessary trials of fitness; but for the bulk of high school girls they are gratuitous miseries, or mere opportunities of vainglorious display.

The evils resulting from overpressure in high schools for girls—whether that overpressure be due to home work, or competition, or examination strain—are brought about through its influence on the cells of the brain, and it is not difficult to understand how these cells are affected. It

is unquestionably true of all cells that when they are in any way stimulated in excess of their powers of taking up nutriment, or deprived of an adequate supply of nutriment, they utilise as food material their own protoplasm, and so induce disordered metabolic processes with subsequent degeneration.

When the cells of the brain are stimulated in excess of their powers of taking up nutriment, as they are during forced mental labour, or when suitable supplies of nutriment are cut off from them, as may be the case during the impairment of digestion which forced mental labour not rarely entails, then the metabolism in these cells is, we may infer, altered, and they degenerate and secondarily induce widespread degenerative changes throughout the system. The group of symptoms which is characteristic of the mental failure which follows upon severe overpressure, and which may be summed up as acute or apathetic dementia, is almost identical with that seen in cases in which mental failure has followed upon acute specific diseases, and in mental failure of the former kind, not less than in the latter, we have also sometimes dilatation of the heart and changes in the liver, kidneys. and voluntary muscles; and in both kinds of mental failure recovery takes place if the fatty degeneration has not so far advanced that the active protoplasm of the cells is absorbed, whenever the cells which have had extra work thrown upon them are allowed absolute rest, and are placed in favourable conditions as regards nutrition.

Besides nervous disturbances, there are many ailments and diseases begotten or fostered by overpressure which medical men are familiar with in high school girls in these days. Chief of these are anæmia and general delicacy. Women suffer from anæmia in far larger proportion than men. In his very able investigation into the physical and mental condition of school children, Dr. Francis Warner has satisfied himself that mental stimulus applied to children "does lower their general nutrition." He found that pale and delicate looking children are proportionately more numerous in schools attended by children of an upper social class and presumably well fed, than in schools attended by children of the poorer class, presumably not well fed; and the only explanation of this he has to offer is that the better class children are subjected to more mental stress than children of a poorer class. A single glance at some high schools, and the complexions of the girls assembled in them, convinces that they are deficient in red corpuscles, however rich they may be in blue stockings.

The anæmia encountered in high school girls is sometimes due to the direct action of mental tension on the blood-forming apparatus; but is sometimes due also to the action of that tension on the digestive functions. Large numbers of high school girls suffer from loss of appetite; a certain number go to school without breakfast. Worn out, they oversleep themselves, and leave scant time for the morning meal; or, after a night of broken rest, they rise unrefreshed, swallow a cup of tea, the neurotic properties of which they have already discovered, but decline solid food, or merely trifle with it. They labour under a gastric disorder now so common that it might receive a distinctive appellation, and be called *anoreria scholastica*, in which the lessened flow of energy from the exhausted nerve centres retards the functions of all the abdominal viscera. Buns in the forenoon, a regular institution at all high schools now, are very well in their way, but they do not compensate for a lost breakfast, and I hold that no girl who has shirked that meal should be allowed to go to school or engage in brain work. It is an axiom that nutrition comes before education.

I have spoken of some of the immediate evil effects of overpressure in high schools—effects which medical men have long recognised, which parents are beginning to perceive—and I wish now to direct your attention to what will probably be its remote effects if it be allowed to go on—effects for which we must wait, but which we have grounds to anticipate with some confidence. The ailments of girlhood which we have ascribed to overpressure do not always end with the cause that induced them, but are apt to plant themselves permanently in the system they have infested, or to blossom into something worse. The headachy girl is not unlikely to grow into the migrainous and invalid woman. A voluminous mental state may develop into epilepsy, somnambulism may lead to hysteria, insomnia lay the foundation of insanity, and anæmia at the growth period may entail lifelong debility. The nervous exhaustion due to overpressure in high schools for girls may be expected to induce a peculiar vulnerability of the pulmonary tissue, which must be intensified by the conditions of work in these schools. The indoor life of the girls, their sedentary habits, and the stooping posture in which they pass much of their time, bring the lungs into a state that is favourable to tuberculous infection. The lungs are comparatively immobile, and there is consequent inactivity of the respiratory current in them, with a tendency to congestion and catarrh.

If it were our object to secure an abundant harvest of phthisis, I do not know how we could better set about it than by providing for general overpressure in schools for girls. Women owe their comparative immunity from organic nervous disease to the comparatively tranquil and sheltered lives which they have led. But if all this is to be altered, if women are to take part in the struggle for life on equal terms with men, then it follows that they will have to a great extent to sacrifice the comparative immunity from organic nervous diseases which they have hitherto enjoyed.

(Concluded from last week.)

SIFTINGS OF THE STUDY.

The Year-Book of Science.

By Prof. T. G. Bonney, D.Sc., LL.D., F.R.S.

(*Cassell and Co: London.*)

This book forms an excellent record of work in the field of science for 1891; and should prove most useful both to advanced and clementary students. It traverses almost every conceivable department, and is a veritable "Whittaker" of Science for the year.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

INOCULATING PLANTS.

A most extraordinary discovery has recently engaged the attention of the United States Department of Agriculture. It relates to the artificial inoculation of growing plants with bacteria. Sooner or later it is sure to prove of enormous advantage to farmers and gardeners, who will be able to assist nature in producing crops by a method never dreamed of hitherto. We have already referred to this discovery in connection with tobacco.

It seems surprising enough to learn that plants which bear pods, such as peas and beans, depend largely for their healthy growth upon bacteria. These little vegetable organisms attach themselves to the rootlets, upon which they feed, forming about each of their colonies a woody tubercle, just as the species that engenders consumption in human beings, and other animals forms tubercles in the lungs. Thus the roots, on which such germs find a lodgment, are found to be more or less covered with little warty excrescences. Until lately it had never been imagined that the tubercles were of use to the plant, or that the latter relied in any degree for its welfare upon the parasites which form them.

Nevertheless, such has been shown to be the fact. Plants are composed largely of nitrogen, and the bacteria described, absorb this element from the air. Indeed this is the only way in which pod-bearing vegetables can procure free nitrogen from the atmosphere. They depend for this upon their microscopic friends, which get hold of the precious material and store it away in the root tubercles, from which it is transferred to the branches and leaves, taking part in building them and thus assisting development.

These matters have been determined by very interesting experiments. It has been found that peas or beans grown in sterilised sand, which of course contains no bacteria, developed no tubercles on their roots and slowly starved. However, by inoculating the plant with proper germs, they were rendered healthy and productive. In other words, they could not get along without nitrogen, of which there was none in the soil; but the bacteria were able to procure from the air enough for them to live upon. It was simply a question of supplying them with small servants to do the work.

There are several ways of accomplishing this. One method followed, for the sake of scientific accuracy, was to take a tubercle from a bean rootlet, cut it open, extract from it a small particle of its substance, and propagate from a piece of this in gelatine a considerable quantity of the bacteria desired. Then some of them were squirted through a little glass pipe among the roots of the plant, with which trial was being made. The same results were obtained, however, by simply watering the soil slightly with a small amount of dissolved earth taken from about a healty bean-stalk.

It must be understood that each kind of pod-bearing plant has its own species of bacteria upon which it depends for a supply of free nitrogen from the air. The tubercle germs of peas do not produce tubercles in beans, and, therefore, are of no use to them. The various forms of tubercle-making bacteria are not all found in every soil. In a field where beans have been cultivated for a long time there may be no tubercle germs for peas at all, or *vice versa*. Accordingly, the farmer would be likely to find a change from one crop to the other a dismal failure, unless he knew enough to procure some earth from the proper place, mix it with water, and thus microbe-seed the land for the new vegtable.

This is the way which the farmer of the future will inoculate his land for whatever sort of pod-bearing crop he may desire to raise. To demonstrate how this may be done with success, narrow strips have been planted in experimental fields with beans and peas. Some of the strips were treated in the manner described, while others were let alone. The results were astonishing. All plants which had been microbe-seeded were easily distinguishable, even at a distance, by their greener colour and larger size. Indeed, where the most assistance of this sort had been bestowed, growth was excessive, so that the plants crowded each other out. The inoculation, simple and inexpensive as it was, had the same effect as would have been secured with the aid of considerable quantities of manure containing nitrogen.

Certainly the importance of this new discovery can hardly be over-estimated when it is considered that in the future the agriculturist will be enabled by artifice to derive from the atmosphere, through the assistance of microscopic organisms, greatly increased contributions to the growth and bearing of his crops.

HOMŒOPATHY.

The desire for truth being the root of all true science, writes Mr. Gerard Smith, I feel sure that you will be ready to insert in your journal some remarks upon one of the answers to "Science Queries," in your number of May 15th, answer No. 93, upon the subject of homœopathy, must have been written by some person who knows not even the first elementary facts of the matter upon which he writes. He says, that the first dilution of a homœopathic drug is made by mixing one grain of a drug with a gallon of water, and taking one drop of this mixture and adding it to another gallon of water, this means that the 76,800th part of a grain is mixed with a second 76,800 drops of fluid. These are the statements of your correspondent.

The facts are these: The first dilution in the decimal scale is made by adding one grain of the drug, or one drop if it be a fluid, to 10 grains or drops of fluid, and the first dilution in the centesimal scale is made by adding one grain, or one drop, to 99 drops of fluid; is there not a large difference here? 10 and 76,800 do not compare very closely, and 99 is not very near to 76,800.

As to the reasonable theoretic grounds of homœopathy, as your correspondent did not enter upon that point (which was the main object of the query), I will briefly state them.

Premising that homœopathy may be practised in any dose, and that the minute amount of medicine is not necessarily a part of the system, I beg to state, that as an homœopathist, I work on these theories (and they have all been proved tenable in actual work), I regard every case of illness as the exhibition of a struggle going on in the body of a living creature, the symptoms evident to my senses, and to those of the sufferer being signs to me of the fight between the disease and Nature's efforts towards recovery. The "vis medicatrix Naturae" is the first article of my medical creed, these signs I try to follow, and I wish to ascertain in what way the natural efforts can best be aided, I find that a large proportion of disease symptoms are such that if smothered or crushed by the adminstration of oppositely acting drugs, the result to my patient is to retard recovery, therefore, I look for some medicinal substances which will act in the same way as these symptoms, not to oppose (allopathy), but to help, the efforts I see going on.

I find that, as a fact, all actively efficient substances are capable of producing in the body symptoms parallel with

those of diffcrent disorders, and also, as a fact, if I use a drug which produces in experiment in the healthy body the train of symptoms which I have before me in a patient, I more often give relief, or cure, than if I use any other.

Secondly, I must not use so large a dose that I increase the sufferings of my patient (though some most striking cases of subsequent cure have arisen after such aggravation) so I select a dose less than will aggravate.

And thirdly, I know that medicinal substances to get into the blood of a living being must do so by osmosis, and therefore, must be administered in a more attenuated form than if I wished simply to provoke the stomach or intestines to get rid of them, (as is frequently done in allopathy), therefore, I dilute them, and obtain effects otherwise unattainable. It is the *form*, not the *amount* of the drug, which is the important point.

These theories can all be tested by convincing experiments. Finally, let me say that we have evidence that there is a more delicats test for many drugs than either the microscopical or the chemical, and that is the physiological, the effects on the living body, which is far more sensitive than the apparatus of the laboratory.

[We have much pleasure in placing Mr. Gerard Smith's theories before our readers, but would point out with reference to the concluding paragraph, that what was advanced by our correspondent was not the suggestion that a point might be reached at which chemical tests would fail, but that a point might be reached at which further "dilution" of a medicinal drug would become a matter of physical impossibility. In reply to a question we have addressed to the writer of the answer, he informs us that his authority for the statements we published is Prof. Tait's book.]

TIME SENSE IN ANIMALS.

Time sense is very highly developed in domestic fowls and many wild birds, as well as in dogs, horses, and other mammals, which keep an accurate account of days of the week, and hours of the day, and have, at least, a limited idea of numerical succession and logical sequence. A Polish artist, residing in Rome, had an exceedingly intelligent and faithful terrier, which, as he was obliged to go on a journey, he left with a friend, to whom the dog was warmly attached. Day and night the terrier went to the station to meet every train, carefully observing and remembering the time of their arrival, and never missing one.

Meanwhile he became so depressed that he refused to eat, and would have died of starvation, if the friend had not telegraphed to his master to return at once if he wished to find the animal alive. Here we have a striking exhibition of time sense as well as an example of all-absorbing affection and self-renunciation likely to result in suicide.

INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. 1, price 1s., post free, 1s. 2d. Or through any Newsagent.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra. Or from Messrs. W. H. Smith & Son, E. J. Stoneham, and through any Newsa

SOCIAL SCIENCE.

SPECIALISM AND SUCCESS.

To succeed is the right aim in life, if we first have a right purpose. There is no inherent reason why any life should be a failure. Nor is it out of the easy grasp of any one to comprehend the elements of success. The first trouble with our moral and financial bankrupts is lack of preparation There is too much belief in genius. For our part we do not know ten persons, and never have known that number, who had what could justly be called genius. On the whole we had best leave that element out of the reckoning. The extraordinary folk, possessed of great self-esteem, are almost invariably our feeblest folk. They are easily inflated, like a balloon or toy bladder; but are punctured by the first difficulty, and left collapsed. Our greatest men are modest men. They are great because they are capable of realising that no one is without weakness and no one very far surpasses his fellows.

No one is so bountifully endowed by nature that he can turn to any subject or any employment and master it at a touch. A few are gifted with one strong fitness and knack; some with two or three marked capacities for comprehending and doing; most of us must rely on special culture for whatever we expect to do well. Genius is undesirable. Generally it means an inherited bias that we cannot escape from. The silk weaver's children, after a few generations, are born under compulsion to weave silk. Most men cannot endure to be confined to one line of action. Still a man likes to feel that he is gifted above his fellows to do some work by magic.

There are two parties of educators—those who believe in general culture, and those who believe in special culture. Of late the special culturists have had preponderating influence They would have each child trained to do a particular thing as well as possible. The general culturist replies: "But that is too much like training society into a great machine, in which each person is a special rod or wheel or screw, and can do nothing but be worn out in that one employment. It may be good for society, but it is bad for the individual.

The true plan seems to be a compromise. Each one should have that amount of general culture that will open his mind to the world and enable him to apprehend the universe of truth about him, and to reap the joys of pure knowledge; but he should also have a special culture for some particular life employment. Journalism offers an excellent illustration. We have seen during the last few years a strong tide set in towards this new profession. How many succeed, do you suppose? Of college graduates, who have a fair general culture, not one in ten can do anything worth his while with his pen. He cannot win his bread by it. The illustration is not exceptional; but no one who has lack of many years' practice in a literary way can hope to finally make journalism a profession for profit. Those who have considerable brain power, and are capable above the average in discussing a few topics of political or social or religious character, are quickly unhorsed in adopting this sort of work for a living. The farmer is an example of the same sort. One hundred years ago every farmer's boy was specially educated to be a farmer. Whatever he needed to know to make agriculture a success, that he learned. He could swing a scythe, turn a furrow, swing an axe, saw wood, dress a sheep for food, and whatever else came in the round of daily life on a farm. But times changed. We began to burn coal, so that no one was the better off for knowing how to

use an axe or saw; reapers came in, and the scythe was useless; dressed meat filled every market, and farmers killed no more home beef or mutton.

What was done? Education went on about as it always had, and the farm boy found himself helpless. He pushed off for the city and dropped into the maelstrom, and was sucked under out of sight. What we need now is an adjustment of special culture for farming. The farm girl no longer needs to know how to make soap, or dye wool, or knit socks, or sew carpet rags. It does not pay. But it does pay for a farm girl to know all about insects that attack the fruit, and all about plants that are grown for food or for mind food. It pays the farm boy, if he wishes to make both living and character, to know all about plant life and animal life. Farming is revolutionised. Education must be revolutionised to match the change.

So we have to lay emphasis on preparation every time. There ought to be more special preparation and more general preparation for every possible employment. A boy cannot be expected to succeed in any employment that he does not understand most thoroughly. The trouble with the vast floating mass is that they know scattering facts, but they cannot put together that which they do know and make an employment out of it. Study your tramp element, and your out-of-employment element, and you find that it is either lacking in special culture or general culture. The trouble is a lack of anything but special culture. When a man loses employment at silk-weaving he can do nothing else. At all events do not think that you can, by force of mental power, tackle a life employment, or turn from one employment to another and succeed. The chances only are in your favour; the solid logic is all against you. You may succeed; you probably will not.

Ah, yes! what have we to say to you when you ask, "What then can I do? I am prepared for nothing; but something I must do." And society has got to answer your question. It must answer it by making a much larger share of education special. Go over to the manual training school and get your hands cultured in this mechanical age. We heard of a youth who was sent to college by his father, an eminent lawyer. The boy was a decent scholar, but he hated his work. He had some bias for mechanics. College would have made a mere calf of the lad. He cried over his vexation. At last he was set free to follow his bent; and to-day he is a fairly good mechanic. Had his general culture been more rational his final special culture would have left him a wider man.

Our next point is persistence. By this of course we do not mean that mere dogged insistence will enable a man to make a business pay that he is not suited for. But there is need of a quiet, cool determination in every department of work in the world. Allowing for the two classes of men who go at a matter—the one as an army storms a city, the other as it lays siege to it; yet the latter class must include nine-tenths of all workers. There is too much of the spirit of experiment among all sorts of business men. They drop in a line, as a man tries for fish. If he does not get a bite he runs on and whips another pool. There are in every community men who have whipped every business pool possible, and have now taken to the puddles.

Speculation and office are the damnation of every man who goes into them as a source of revenue. Even the big swindlers and lucky candidates collapse after a run of fortune. No business is worth the while that involves ventures—that is, such ventures as we cannot fully cover and fully measure. But you say a farmer ventures who plants a crop of corn. If a farmer puts all his land to corn, and runs the risk of low prices, or of a bad harvest, he is a speculator, and will soon drop through. But it is safe to count on our crops if we have a reasonable variety of them; for we know well that year in and year out not more than one sort of crop out of five fails. Prices can be anticipated on the same basis. But the bulk of our business men cannot content themselves with sure things.

Economy is better than an income. The great curse of life is lack of knowledge as to the preservation of what we have. It is estimated by good judges that one-half of all that we produce, or might produce, is wasted. Part of this is due to ignorance, and part to our reckless habits. It is not the size of our income that determines happiness, but the use we make of what we have. This lesson is a hard one to learn. We long for huge accumulations. There is a vague idea that wealth is pleasure. One-fourth of all misery in the way of financial failure comes from bad habits about small leakages. Study successful men in every department of life, and you will find that they are not above saving, even millionaires have nearly all been noted for careful supervision of expenses.

What is economy? It is never exactly the same thing in two persons, but there is one economy that belongs to all; that is the wisest *use* of all that he has. You may take fifty persons, as they occur to you, in the poorer and dependent walks of life, and you will be surprised to find how freely they spend what they get. Economy need not however, involve penuriousness. Ruskin defines it in a way to include honour, and he is right. He says: "Economy, whether public or private, means the wise management of labour, and it means it mainly in three senses, namely: First, applying your labour rationally; secondly, preserving its produce carefully; lastly, distributing its produce seasonably." True economy covers the use of property.

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

Trees Attract Moisture. The Reason.

Goddy.—The whole problem of a tree's life and growth and its work and uses is of the deepest interest and importance. Without some such general knowledge, we are unable to carry in our minds a connected and logical idea of the universe, and certainly cannot intelligently understand the animal and human mechanism. For the protoplasm of the vegetable kingdom is the beginning of moving life, and this substance is the beginning likewise of all other forms of life, man included. Microscopically and chemically it is the same throughout the whole living creation. A tree eats, digests, breathes in and out, sleeps, reproduces its kind, and, therefore, grows on the same plan as man and animal. These vegetable functions are, however, much less complex than the gradations of higher life, and, therefore, can be studied by the chemist and microscopist with less difficulty. Thanks to the great improvement of the modern microscope, which can discern an object as much smaller than a house fly, as a house fly is smaller than an elephant, these vegetable wonders are no longer matters of speculation, but have passed into the region of exact fact, which any of us with the requisite knowledge and instruments can verify for ourselves. With these preliminary remarks, we will try to explain to you why trees attract moisture, as it is termed. One part of the food that the tree requires for its nourishment is obtained from the ground, and the rootlets, besides being its mode of support, grow in all directions to obtain this food. This food is contained in the minerals of the ground, which must be in a state of moisture for the rootlets to absorb it. In this liquid state it enters the sponge-like formatian at the end of these root fibres by a principle termed *endosmose*, and then by the law of capillary attraction passes from cell to cell to the main root, up through the stem and branches till it reaches the leaves. In the leaves mostly on their underneath side, there exists a number of little openings, strangely like pursed-up human lips, called stomata. Through these little

openings the water of the liquid food passes into the air, while the mineral food remains in the plant to mix with the carbon, which in its turn has been taken in by these same stomata and extracted from the carbonic acid gas of the atmosphere. Then by a chemical arrangement of these different elements the perfected food is formed, that passes along the underneath sides of the leaves to the growing cells in the different parts of the tree which require it. It has been calculated that an oak tree with 700,000 leaves will send forth in a year, in the manner we have described, 226 times its own weight of water. You can now readily understand that a large quantity of trees together will considerably add to the vapour in the air and so help it to pass its point of saturation, and as a consequence rain will fall. The cutting down the trees of a district has often altered considerably its rainfall. In densely populated districts it is of the utmost importance that every spare spot should be planted with trees, as by their breathing in carbonic acid gas and sending out oxygen the air is purified.

THE TEMPERATURE BEGINS TO RISE AT MIDNIGHT: WHY?

R. HUMPHREYS.—The earth during the day absorbs a certain quantity of the sun's heat, which heat it gives off at night. When there is a quantity of vapour in the air it hinders this radiation, and so the temperature falls but little; but when the quantity of vapour is low the temperature falls. The relative humidity of the air is greatest near the surface during the night. The facts you mention are probably due to the relative humidity and vapour in the air. As regards the other question, as to whether heat expands the particles themselves or acts as a power to overcome the force of cohesion, from the many different experiments made in physics, we are bound to assume that all things are made up of particles so infinitesimal, that they cannot be seen under the most powerful microscope, and that a point of smallness of the particle is reached which is indivisible. Each of these particles contains within itself a force which brings them together to form the three states of matter. If this force of cohesion had its entire way, a moveless universe would result. But movement, principally from the sun, partly prevents this by setting these particles in violent agitation; and the fight between the force of cohesion and the energy of movement determines the different states of matter. In the atmospere, the energy of movement overcomes the force of cohesion, and so the particles of the atmospere bound and re-bound away from each other in straight lines. Heat, therefore, cannot expand the particles, but tends to overcome the force of cohesion.

THE INFLUENCE OF THE MOON ON THE WEATHER.

F. G. PROVIS.—We refer you to page 13, where it is stated as our belief that, although the moon certainly does give rise to tidal effects in the atmosphere, these effects can, from the view-point of practical meteorology, be neglected. If you can cite any reasonable grounds for the contrary opinion, we shall be pleased to hear from you.

FERROTYPE PLATES FOR PHOTOGRAPHY.

H. D. MUNDAY.—Ferrotype plates, or, as they are vulgarly termed, "tin types," were, until recently, bought unsensitised, and coated by the photographer just before making his picture. Mr. J. Fallowfield, of 36, Charing Cross Road, has, however, lately introduced what he terms "Ferrotype Dry Plates," which are ready sensitised, and will thus save you much trouble. We would recommend you to write to this firm, which supplies full instructions for use with these plates.

C. F. STATER, F. W. GOODMAN, P. FRASER.—Many thanks for your communications. The velocity at which light travels, as you point out, is 186,000 miles per second; hence the discrepancy.

MISCELLANEOUS.

A READER.—Try fly papers placed near the window. Paper dipped in a sweetened solution of quassia is efficacious.

BEGINNER.—"Mind in Animals," by Buchner. Published by the Free-thought Publishing Company, 28, Stonecutter-street, E.C.

BONNYRIGG.—In our last issue we stated that we did not know of the chemicals you require. The cost of a working photographic outfit is from £2 to £30 or more. You must naturally try and sell your photographs to shops or people to make it profitable.

MALDRETT AND GILCHRIST.—In our next issue we will tell you why perpetual motion is impossible.

A.C.G.—We do not in any way mark the photographs sent us for the porcelain enlargements. We identify them by means of a small numbered label, which is removed without in any way marking the picture back or front. You need, therefore, have no anxiety on this account. With regard to your remark as to the position of our announcement, we intend removing this as soon as the portraits are thoroughly known.

Prizes for Amateur Photographers.

We include among our readers so many who practise photography, both for pleasure and scientific research, that we have decided to start a series of competitions, which we shall continue through the season if the interest is maintained. The first competition will consist of

Six Prizes.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co. for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A camera for making enlargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a separate coupon, firmly attached thereto.

The last day for sending in photographs, slides, or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet Street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday June 28th, 1892.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. DALLMEYER "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, 25, NEWMAN STREET, LONDON, W.

SCIENCE SIFTINGS
CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6s. 6d. 6 *months*, 3s. 4d. 3 *months*, 1s. 9d

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

LONDON: SATURDAY, JUNE 4, 1892.

SCIENCE NEWS AND NOTES.

Absence of occupation is not rest,
A mind quite vacant is a mind distress'd.
—COWPER.

The Fatality of Flats

and tenement houses to human life was referred to under this column in our last issue, Dr. Poore also points out the evils that arise from dwelling in that modern outcome of overcrowding, the monster hotel. Each floor ventilates into the floor above and the floor below, while the "lifts" effectually drive the air from one floor to another without renewing it. In such places, where hundreds live under a common roof, fresh air is impossible. Dr. Ogle, in a recent paper on "The Relation of Occupation to Disease and Mortality," pointed out that the mortality of hotel servants was higher than that of any other class, being nearly four times as great as that of the clergy, who enjoy the lowest degree of mortality. This high mortality is not to be wondered at, for the hotel servant lives day and night in an overcrowded dwelling redolent of humanity, dinner, gas, tobacco, and drains, one or all, most commonly all. Alcoholism may have something to do with this high mortality, but we must all admit that the unwholesome conditions of life are probably the main cause of the alcoholism. The advantages of hotel life are many, and the charms of living in a pleasant community are very great. These charms have always been recognised, but when we contrast the "college," as seen at Oxford or Cambridge, with its ample area and the opportunities for society or seclusion at will, with the modern hotel, raised tier above tier, in which tranquility and fresh air are alike unknown, it must be confessed that, æsthetically and hygienically, the mediæval architect was ahead of his successors. Those establishments erected in health resorts and by the seaside, which have been designed for the reception of delicate persons and invalids, and which are well calculated to bring chronic maladies to a termination are referred to, as well as the great hostelries of the cities.

Our Plea for Trees

in the streets of London and other great cities has brought us many sympathetic letters, but no real activity has been aroused. We pointed out in our last issue, under "Helpful Hints," the importance of tree life to humanity. Dr. Poore has also broached the subject, from another view point. Not only do the green leaves of plants absorb carbonic acid from, and give off oxygen to, the air, but their roots are no less useful in draining and purifying the soil upon which we live. We have heard a good deal about the dangers of impure soil, and the advice with regard to it is invariably to put something which is impermeable, such as concrete or asphalte, to prevent the rising of possible impurities from the earth. This is analogous to putting dead bodies into impermeable coffins, whereby the danger of their decomposition is not prevented, but merely delayed. The only way to purify the soil is by cultivation, æration, and the growth of plants. Dr. Poore is of the opinion that an evergreen creeper, such as ivy, does more to keep the foundations and walls of a house dry and pure than do any of the patent impermeable applications.

The Strongest Anti-Cremation Argument

that we have yet heard is likewise advanced by the same excellent authority on sanitation. Dr. Poore describes cremation as wasteful since it involves a needless expenditure of fuel, and helps to still further pollute the air of our cities by products of combustion, always poisonous to breathe, and not always odourless. Dead bodies, he opines, should be left to nitrify in the earth and provide nourishment for trees which, while affording us timber and firewood, would at the same time effectually cleanse the soil of its impurities and render it fit to be used for burial a second time. The advocates of cremation say that this economic argument is false because the products of combustion are indestructible, and must ultimately go to nourish plants somewhere or somehow. This is doubtless true, and by parity of reasoning we might do well to throw our money into the street instead of paying it into the bank, and we might advocate the fertilising of the market gardens round London by setting fire to the manure in the London mews. The necessity for burying the dead which hitherto has existed has had the indirect effect of separating the living and preventing to some extent the overcrowding of houses. If our cemeteries are to be replaced by furnaces with tall chimneys pouring noxious gases into the air, and if the ground which would be occupied by cemeteries is to be covered by houses, it is clear, he continues, that we shall gain nothing from a sanitary point by the introduction of cremation.

Physical Courage,

in so far as it is the outcome of physical energy—of constitution and temperament, for example—is physiological in its nature and origin. It is often, as our contemporary the *Lancet* points out, the resultant of a young and vigorous vitality, prodigal of life, in which the whole animal machinery is adjusted in harmonious action and toned with the right sort of temperament. The nervous centres are irrigated by blood streams pumped into them by a vigorous heart; the tissues flow with healthful sap, and the will moves straight along the highway to action, without lingering in any by-path, to be "sicklied o'er with the pale cast of thought." Men of this stamp seem to be without any sense of fear whatever. Deeds of daring are to them but a pleasurable excitement; risk and danger simply add a *soupçon* of exhilaration to the work. This is a form of animal courage, of an eager and tempestuous

sort for the most part, born in certain men and races. It is a terrible force in attack, but liable to panic, and unstable in so far as it is influenced by fluctuations in health. There is another type, the antithesis of this, in which great courage is manifested by those who are popularly styled highly-strung nervous men. Under excitement, or when suddenly called upon to face great danger, and under states of nerve tension, such men become cool, deliberate, and altogether regardless of fear. They are frequently men of marvellous resolution. The pallid face and apparent manifestations of "funk" are really but an outward sign of the inward working of the physiological mechanism.

Education and Thoughtfulness

may have a weakening effect on physical courage, which in the main, as we have already pointed out, depends upon physical qualities, and is fortified by discipline; and it becomes a nice point, to determine whether the increase of the soldier's efficiency in one direction, by education and the exercise of his intelligence, may not be diminished in another, when troops are called upon to undertake the self-sacrificing duty of a highly hazardous or impossible service for some great, but to them unknown, strategical gain. It requires the absolute obedience of an unreasoning mind to attempt the impossible for an unknown object. Courage under such circumstances, says the *Lancet*, is the fruit of the tree of ignorance, and not of knowledge. Fearlessness is often the result of ignorance of danger, as in the case of children and some semi-civilised nations. The bravery of some men is intimately associated with their vanity. Apart from vanity they are cowards. They will do anything so long as it is in the presence of spectators or in the expectation of fame and praise. Although courage is born in a man there are some excellent substitutes for it, such as the force of fanatic zeal and fatalistic belief; and it can be wonderfully developed —it may almost be said to be created—by training and by familiarity with danger, provided it be not a danger that dominates the imagination with a feeling of powerlessness. The courage of even the bravest man is not any fixed quantity. It is not always the same by any means. It depends greatly upon varying but unrecognised states of health, for one thing; and for another, perfectly new kinds of experience will sometimes impress the imagination and instil timidity.

How to tell Death

has been frequently referred to in our columns, and we have already published the most generally approved method of ascertaining whether life is extinct in a body. Another opinion just advanced by a rising French physician upon the subject is, however, of great interest; for no means should be left untried to prove beyond a doubt that life is actually extinct before conveying our loved ones to the grave. Doctor Martinot asserts that an unfailing test may be made by producing a blister on the hand or foot of the body by holding the flame of a candle to the same for a few seconds, or until the blister is formed, which will always occur. If the blister contains any fluid, it is evidence of life, and the blister, only that produced by an ordinary burn; if, on the contrary, the blister contains only steam, it may be asserted that life is extinct. The explanation is as follows:—A corpse is nothing more than inert matter, under the immediate control of physical laws, which causes all liquid heated to a certain temperature to become steam; the epidermis is raised, the blister produced, it breaks with a little noise, and the steam escapes. But if, in spite of appearances, there is any remnant of life, the organic mechanism continues to be governed by physiological laws, and the blister will contain serous matter, as in the case of ordinary burns. The test is as simple as the proof is conclusive. Dry blister: death. Liquid blister: life.

Experimental Psychology

we may note in connection with our recent articles on the brain, is a comparatively new realm of research, and we may confidently expect from it most valuable aid in defining the differences between the races of men. Its main object may be said to be the measurement of the relative rapidity, intensity, and persistence of mental actions. This means that it endeavours to discover material gauges and mathematical formulas for the sensory, motor, and intellectual processes. Think what this involves! Nothing less than that we shall be able to measure the mental abilities of a man as we do his height and girth! Though this goal is probably theoretical, as the individual generally eludes averages, these are true for the mass, and we may be sure that a series of observations on, say 20 pure adult types of the races would yield results markedly different and highly significant. The points to be examined are such as these: the rate of muscular movement, rapidity of nervous impulse, transmission of motor and sensory stimuli, race differences in reaction times, sensation areas, differences in estimating weights, judgment of the passage of time, sensibility to pain, the rate of forgetting, etc. With the excellent psychological laboratories now in operation at several of our leading universities, these comparative observations could readily be made, and they certainly promise most important results.

The Intellect of Animals

we inferred in a recent article was too low to permit of suicide. A correspondent, Mr. S. C. Redman, of Eastbourne, sends us, however, what practically amounts to a contradiction of this belief, although he declines to vouch for the accuracy of the story. It is to the effect that a monkey in the Philadelphia Zoo tried to commit suicide by cutting his throat with a piece of glass after his mother had whipped him. He made a frightful gash before his mother took the glass away. This, after all, is only an American story, and we cannot verify it, but it is more probable that the accident was the result of the monkey trying to shave, an attempt that will often be made when the keeper is in the habit of performing this operation on himself before his charges. The imitative faculty of monkeys is very largely developed.

A Prehistoric Mound

has been found in Southern Texas, which equals in size the the greatest effort of the mound-builders yet discovered in America. It is located in the lower part of Fort Bend County, near the line of Matagorda. The traveller roaming over the broad prairies in that section suddenly sees in the distance a huge mountain-like object. He cannot fail to see it, and he quickens his steps in that direction until he finds himself before a cone-shaped hill, covering about four acres and rising above the open prairie fully 200 feet. There is everything to indicate, even to the unskilled eye, that the mound is not natural but artificial, and that in ages past it was higher than it is now; and the more it is examined the stronger becomes the spectator's curiosity. There is no other hill or conspicuous object in the vicinity; the monotonous prairie stretches away unbroken for miles in all directions. There are no excavations to show the source of the earth used in its construction, and the theory has

been advanced that it was built with the alluvial soil from the valley of the Brazos River, some miles away. It becomes evident to the observer that the earth composing the mound is different from that of the surrounding country, and is more like the river bottom. It is not so easily washed away, and this explains why the mound has remained for centuries, in almost perfect shape. Some people say that excavations will show that the mound is made of huge sun-dried bricks, or blocks of mud, such as the Mexicans commonly use to this day.

Another Peculiarity

about the mound is that the vegetation on it is different from that growing in the surrounding country, and is always green and luxuriant. Old-time settlers state that when they first came to the country a spring of water was flowing out at the top. The water possessed medicinal qualities, and was used in sickness by the Comanches and other nomadic Indian tribes and subsequently by the whites. The water had the same effect as calomel, and was beneficial in malarial troubles. In the early days the water used to be carried to Richmond, Texana, and other neighbouring points, and found a ready sale at a fair price. Many of the local physicians endorsed it, and made use of it in practice over the country. The spring no longer flows from the top, but its pathway over the mound is clearly defined. There is no doubt that the mound was made by human hands, and is a remnant of an ancient race, and should be scientifically examined. It is locally known as Damon's Mound.

Tapping the Telegraph Wires

for prize tit-bits of sporting information is the pastime, says a New York contemporary, of the bad telegraphists in and about that enterprising city. We mean the bad telegraphists in a moral, not in a technical, sense; for we are informed that "great expertness" is essental to success in the profession or art of wire tapping. One of the most remarkable statements made by our contemporary is that these sharp practitioners, by whom it is said a lot of money has been made, are not amenable, even when their business has been fully exposed, to any law of the United States.

British Sportsmen,

by which we mean, of course, the British bookmakers, need not, however, be under the apprehension of any invasion of their most honourable system of money making by such "outside operations." For, in the first place, we imagine that scant prospect of immunity for this particular development of the betting business exists under the English laws or would be found in the neighbourhood of English racecourses. Obviously the risks incurred by interfering with telegraph wires are much increased when the attempt is made in a thickly populated country. But there is another and still greater safeguard of the secrecy of the telegraph service, and that is the duplex system of transmission, by which messages can be forwarded simultaneously from the opposite ends of a simple wire. Of course, the adoption of this system effects an enormous economy in the outlay for telegraphic plant. And equally, of course, most English telegraph lines are duplexed.

No Current Passes,

or at least no appreciable current passes, through the wire when signals are exchanged upon the duplex system; and it will be understood from this fact that enormous and perhaps unsurmountable difficulties exist in the way of tapping a main telegraph line effectively. It is only in the short wires connecting racecourses with main telegraph stations or connecting the latter with the clubs or pool rooms that, tapping instruments can be inserted. Here it cannot be said that any great amount of skill would be required to gain complete control over the messages transmitted. A pair of ordinary telegraph operators with their instruments and with a few yards of wire would do the trick, and if it were only to "overhear" the messages passing it would be enough for anyone acquainted with the Morse alphabet to provide himself with a length of wire, formed into a triangle, having one of its sides near to and parallel with the wire to be interrogated, and having a Bell telephone placed in the circuit at one angle of the wire triangle. Electrical induction would do the rest.

The Alphabet,

according to a legend credited by Plato, was disclosed to man by the gods themselves. Certain it is that down till to-day we have reached no positive data as to its origin. It appears that the old notion that the Phœnicians discovered the letters must be abandoned. Dr. Eduard Glaser, whose long and arduous researches into the epigraphy of Southern Arabia promise to throw an unexpected light on a large tract of ancient history, expresses himself quite positively that it is in Arabia we must search for the beginnings of this marvellous invention, and probably in Southern, Arabia. There, perhaps nearly three thousand years B.C., the ancestors of the Minæans and Sabeans appear to have developed several related phonetic alphabets, from some one of which the so-called Phœnician was descended. Dr. Glaser has obtained copies of some of these as yet undeciphered inscriptions, probably more than four thousand years old.

The Early Egyptian Hieroglyphic Writing

may have suggested the alphabet, but it seems sure that the Egyptians themselves never developed it. What is more remarkable, and it seems has not received sufficient attention, is the gradual degenerationn of the early Egyptian phonetic hieroglyphic system into one mainly ideographic and symbolic in the late demotic writing. The signs in the latter have often no more relation to sound than have the symbols of Chinese script. Thus, three points between two vertical lines, | . . . |, means, in the demotic, "man"; but it was in no way understood to represent the sounds which were in the word *roemt*, man, in the spoken dialect. This degeneracy gradually arose from changes in the phonology of the tongue, while the hieroglyphic signs were continued unchanged. It is, of course, nothing new to Egyptologists; but to the ethnographer and the historian of the arts it is a noteworthy instance of retrogression in one of the most useful and highly prized inventions ever made by man, and that in a country of continuous and unbroken culture.

The Curvature of the Earth

is in round figures, 8 inches in a mile. That is, a horizontal line touching the surface of the ocean at any point would be about 8 inches above the ocean's surface a mile from that point. The curvature, however, keeps on increasing as the squares of the distance. While it is 8 inches for one mile, it is 32 inches for two miles. 72 inches three miles, 128 inches for four miles, etc.

GLEANINGS OF THE GLOBE.

An alligator in the Crystal Palace aquarium has not tasted food for eighteen months.

Mons. Flammarion, the French astronomer, states that from actual figures obtained within the past six years, the temperature of Europe has been falling.

Dr. Gerdes, of the University of Halle, is reported to have discovered the long-suspected bacillus of epilepsy in the liver, lungs, kidneys, and blood of a patient.

It is stated that wasps' nests often take fire, supposed to be caused by the chemical action of the wax upon the paper material of the nest itself. This fact may account for many mysterious fires.

The science and secret of dreams is beautifully and pithily expressed by Dr. Richardson, who states that "all musical instruments dream after they have ceased playing, and a microphone will detect their dreams."

In 1861 (according to the returns of the Inspectors of Mines) 305 tons of coal per annum were raised per male person employed in the British mines; in 1870, 316 tons; in 1881, 314 tons; and in 1890, only 299 tons.

An electric tuning box for the use of leaders of orchestras and others interested in music has been invented by a Frenchman. It consists of a dry-pile battery connected with an electric magnet. When placed on a sounding board, the required note is obtained by moving a small commutator located in the box.

The recent discovery of prehistoric copper implements on the sight of an ancient Indian village, near Betterton, Md., is considered as furnishing another link in the chain of evidence that among the most remote tribes there existed a system of intertribal trade.

It has been discovered by Professor Duner, of Berlin, that the revolution of the sun, as shown by the movement at its equator, is once for 25 days and 12 hours of our time, while at, or near its poles, the revolution may be only once in 46 of our days. This would only be possible with a movable and gaseous surface like that of the sun.

In an article in the current *Century*, Edmund Clarence Stedman writes about "What is Poetry?" and makes the following comparison. "It is true that the poetic essence always has been a force, an energy, both subtle and compulsive; a primal force, like that energy the discovery of whose unities is the grand physical achievement of this century."

Prof. Lewis Swift, of Warner Observatory (U.S.A.), reports the discovery of a new comet. Spreading out from the head is a complicated system of tails. At least a dozen distinct branches can be counted on the photograph, some of which present remarkable curvatures. One telescopic view exhibited the fact that in less than twenty-four hours the third tail had formed to the extent of about 10,000,000 miles, while the northern tail had entirely disappeared. Portions of the tail were seen to form an abrupt angle with their original source.

Mr. Poultney Bigelow tells the following story of Edison's deafness: "I asked him how it was that an inventor who had brought the telephone so near perfection could do nothing for his own hearing." "I could if the drum were sound," replied Edison. "When I was a boy I sold peanuts and newspapers on the railway trains. One day a baggage porter lifted me from the ground by my ears—the membrane snapped, and that is how I became deaf."

The eruption of peat bogs and the stream of dark mud these give out, has recently been the subject of study by a German scientist. He rejects the explanation that it is due to excessive absorption of water by the peat, or that it is caused by exploding gases, but attributes it to landslips of the ground under the bog, and remarks that in Ireland the eruptions are most frequent in limestone formations with caverns and bodies of underground water.

We saw recently an ingeniously constructed clock at the establishment of a Portsmouth tobacconist. In place of the ordinary clockface, the works were surrounded with coils of tobacco, and on these coils cigarettes were arranged in the form of Roman figures, giving the hour. The hands were a pair of clay pipes. The whole design formed an excellent advertisement for Messrs. Ogden's well-known "Otto de Rose" cigarettes and "Fruit and Honey" tobacco.

The monkey's intelligence has never been able to arrive at a point which enables that animal to achieve the untying of a knot. You may tie a monkey with a cord, fastened with the simplest form of common knot, and unless the beast can break the string or gnaw it in two he will never get loose. To untie the knot requires observation and reasoning power, and though a monkey may possess both, he has neither in a sufficient degree to enable him to overcome the difficulty.

A very common idea among people who have not carefully experimented is that horse hairs, if laid in the water, will, in the course of time, change to small worms. This superstition has no foundation in fact, and probably arose from the circumstance that in stagnant water there are often found what are called hair worms, very long black worms, which on casual examination have the general appearance of horse hairs.

Many a man is rich without money. Thousands of men with nothing in their pockets, and thousands without even a pocket, are rich. A man born with a good, sound constitution, a good stomach, a good heart and good limbs, a pretty good head piece, is rich. Good bones are better than gold, tough muscles than silver, and nerves that flash fire and carry energy to every function are better than houses and land. It is better than a landed estate to have the right kind of a father and mother. Good breeds and bad breeds exist among them as really as among herds and horses. Education may do much to check evil tendencies or to develop good ones, but it is a great thing to inherit the right proportion of faculties to start with. The man is rich who has a good disposition, who is naturally kind, patient, cheerful, hopeful, and who has a flavour of wit and fun in his composition. The hardest thing to get on with in this life is a man's own self. A cross, selfish fellow, a despondent and complaining fellow, a timid and care-burdened man, these are all born deformed on the inside. They do not limp, but their thoughts sometimes do.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 31.

109.—Why does the sun appear to lose its circular form as it approaches the horizon?

It is owing to the refraction of light in our atmosphere that the disc of the sun appears to become flattened as it sinks in the Western sky. When light, travelling in a rare transparent medium, impinges obliquely on a transparent medium of denser character, the front of the light wave is twisted round into a direction more nearly perpendicular with the surface encountered. This twisting round, or refraction, exhibits itself very distinctly in the case of those beams of light which reach us just before sunset. The earth's atmosphere is not of uniform density and refractive power, but may be considered as a series of concentric spherical layers, each of them less active in bending light rays than is the layer immediately beneath it, hence the light in question is not simply bent towards the perpendicular at the surface of the earth's atmosphere, and afterwards transmitted through the air in straight lines. It is continually acted on by successively denser layers of air, and compelled to travel in a curved path. Of course, the human eye affords no test for curvation of this sort, and, to the observer, the solar disc appears to lie in the direction last assumed by the continually bending rays. The sun is made to appear higher in the heavens than it really is; and since the rays from the lower edge of the sun's disc have not only passed through a greater thickness of the atmosphere, but have entered it more obliquely, and traversed some of its densest layers, it follows that these rays from the lower half are more refracted—that the lower half of the sun is apparently raised through a somewhat greater angle than the upper. Thus the vertical diameter is shortened, while the horizontal diameter remains unaffected; and, therefore, the phenomenon in question is explained.

110.—Is it a fact that steam engines will run more or less steadily, according to how they are placed, with respect to the points of the compass?

Yes; the most favourable position for a rotating shaft is parallel with the earth's axis, *i.e.*, in a north and south direction. The reason is that every rotating body offers resistance to angular motion or twisting of its axis of rotation. Any axis that does not lie horizontally in a north and south direction must be continually twisted by the motion of the earth relatively to surrounding space. The resistance opposed to this twisting, which is the motive power in Foucaoult's celebrated gyrostatic experiment, causes strains and slightly unequal friction in high speed shafting that is not laid as recommended.

111.—How does the use of oil prevent heavy seas from breaking over a ship?

What is called surface viscosity renders the superficial film of a liquid tough or viscous as compared with the interior portions of the same fluid. Surface viscosity can be demonstrated by sprinkling a layer of fine dust, such as lycopodium, on the surface of water in a basin. A floating stick, caused to turn slowly, carries with it the superficial layer of the water, thus proving its relative rigidity. This condition of the surface may be compared to a skin of indiarubber that has to be rent before a water wave can break. There is another point, regarding the surface layer of water as an elastic skin, and that is the tension to which this skin is exposed under normal conditions. It is called simply the superficial tension of the liquid. Evidently the greater is the superficial tension, the more easily will the skin become broken when the liquid is agitated. But the effect of a thin film of oil is to reduce the superficial tension, and at the same time to increase the superficial viscosity. Hence the tendency of waves to break up into surf is combatted, and their surplus energy, diverted from destructive manifestations at the surface, expends itself upon the production of eddies in the subjacent fluid.

112.—What scientific explanation is there for the phenomenon vulgarly known as "the sun drawing water"?

The phenomenon is simply due to beams of sunlight finding their way through apertures in the clouds, and partly interrupted and reflected, or "scattered," by the fine suspended dust with which the atmosphere is filled.

113.—What is the simplest method of regulating a clock when no astronomical or other instruments are available?

The simplest, and, undoubtedly, the best method of rating is by comparison with the sidereal day of 23 hours, 56 minutes, 4·1 seconds. It is only necessary to set up a horizontal wooden board at the edge of the roof on a high building—the board lying due north and south, and having its outer edge set perpendicular by the aid of a plumb-line (which one could hardly consider to be an "instrument"). The observer stations himself immediately below the vertical edge of this board, and he looks up at it through a small hole formed in a plate of metal nailed to a support. A bright star (not a planet) is sighted, and time by the clock is noted. The observation is, of course, repeated on the following night, and preferably on several succeeding nights, and a very accurate rating may thus be obtained. It is necessary, by the way, that the edge of the wood board should be made perfectly smooth and straight, otherwise the variable refraction of the atmosphere might cause a star to appear one night at a prominence, and another night a little to the north or south of this, and perhaps at a depression on the edge of the board, so that the true sidereal day would not be measured.

114.—How is the power of a burning-glass estimated?

Approximately, the temperature at the focus of a burning-glass is that which would result from the unconcentrated rays of the sun, if they impinged on matter situated at a point where the angle subtended by a diameter of the sun's disc, is equal to the angle subtended by a diameter of the lens at its focal point. It is said that the largest lens ever made virtually transports the matter at its focus to a distance of only 250,000 miles from the sun, *i.e.*, to about $\frac{1}{100}$ of the actual distance of our luminary. Although no exact measurement of the temperature was obtained, it must have been equal to that of a powerful electric arc, as platinum, agate, fireclay, and other highly refractory materials are easily fused.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

121.—Why does a shower of rain calm troubled water ?
122.—What is the meaning of lap and lead in a steam engine ?
123.—In what way could the precise position of the North Pole be determined by an arctic explorer who should reach it ?
124.—How deep would it be possible to descend into the earth by mining ?
125.—How much is a rifle bullet diverged owing to the rotation of the earth ?
126.—What is the greatest proportion of the earth's surface that can be seen at one time ?

THE CAUSE OF EARTHQUAKES.

It is not practicable, within the scope of a limited article, to present the various theories which have been held with regard to the cause of earthquakes with their varied phenomena under general dissimilar conditions.

Without doubt the consensus of judgment among physicists is that earthquakes result from the shrinking of the surface of the earth from the ceaseless dissipation of its heat into the cold of space. As this loss of heat progresses, strains are inaugurated throughout the surface of the earth, and on account of that surface being of unequal strength there arrives a moment when a breaking of a portion of the surface takes place along the weakest part thereof. Every miner is familiar with the "faults" which he encounters in the line of his drifts, and rarely can he tell whether the continuation of his vein is above or below him when he comes to a bare wall at the abrupt end of his vein. It is well known to geologists that these faults are of extraordinary depths, as shown in the region cut through by the canyon of the Colorado.

The phenomena attending these great disruptions are weakly exhibited in the earthquakes of to-day, when small dislocations occasion comparatively great results. In the great earthquakes in Japan, notably in that of 1854, and in recent great earthquakes along the Andean coast of South America, there have been relatively small changes of surface that have exhibited but little change of the surface of the earth. Nor has there been any exhibition of forces in these earthquakes that cannot be explained on the theory of the rupture of a relatively very small area of the earth's surface. In the great earthquake of Krakatoa a few years since, there was an unusual exhibition of explosive forces accompanying the disruption of the surface, when volcanic agencies blew up half of a high, rocky islet and left a great depression below the surface of the water. There has been no such other exhibition in modern times, for the material of the islet and the submarine material was projected into the higher atmosphere in very minute particles, and gave rise to the extraordinary exhibition of the beautiful red skies visible near sunset. This matter was carried around the whole earth in the higher atmosphere.

The mechanical theory of heat will readily explain how a great disruption of the earth's surface may produce all the phenomena of volcanic action, when the conditions of the material and the extent of the rupture are favourable. Imagine what must have been the intensity of the heat developed, when faults of one mile deep were formed, and the terrific friction of two surfaces of such great extent were involved. We only can approach the subject by the mathematics of the theory of heat, and certainly not by any experience.

Along this coast the lines of rupture of the weak parts of the earth's crust are shown in the depression of the plateau of the Pacific Ocean bed and the parallelism of at least four lines of coast mountains, and the great backbone of the Sierra Nevada and the Cascade range. And these lines and the closely adjacent country must be the seat of seismic changes, as the earth gradually loses its heat. We have the evidence clearly before us that along the line of rupture of these ranges there have been many outflows of lava, forming the basaltic layers visible in the Sierra Nevada in certain localities, and especially in many outflows along the northern part of the Cascade range.

The dynamical theory accounts for these resultant exhibitions, and it is easy to imagine that there must have been many other concomitant exhibitions of electrical and volcanic forces. In the great chain of the Aleutian Islands, where so many extinct and active volcanoes exist, every earthquake along this weak line of the earth's surface is accompanied by renewed activity in the living volcanoes, and it may be safely assumed that all the phenomena may be traced to the contraction and rupture of some part of the surface or crust from the ceaseless but slow cooling of our planet.

THE PHILOSOPHY OF FIRE.

The following is a description of the process of combustion in the ordinary lighting of a coal fire: The phosphorus on the match inflames at the low temperature of 150 deg. F., and mere friction ignites it. In burning it combines with the oxygen of the air, and gives out heat enough to raise the sulphur on the match to the ignition point of 500 deg. This combines with more oxygen, and gives out sufficient heat to raise the temperature of the wood in the match to 800 deg., at which point it combines with oxygen to give out a temperature of 1,000 deg., which raises the coal to a temperature required for ignition, and the latter takes on more oxygen, rising to the temperature of 3,000 deg. or more, according to circumstances. The ignition of the coal is the last in a series of progressive steps, each increasing in temperature.

SIFTINGS OF THE STUDY.

Farmyard Manure.

By C. M. Aikman, M.A., B.Sc., F.R.S.E., F.I.C., F.C.S
(*Blackwood and Sons.*)

"Farmyard Manure: Its Nature, Composition, and Treatment," forms the subject of this interesting hand-book. Mr. Aikman, who is an authority on agricultural chemistry, has treated the question in a most able and readable manner, and those interested in the culture of the soil will find the book well nigh indispensible. (Price 1s. 6d.)

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.

Or from Messrs. W. H. Smith & Son, E. J. Stoneham,

and through any Newsagent.

THE KEELY MOTOR.

The Keely motor again! Yes, but this time it is presented under a much more favourable aspect than was the case some years ago, when, as many of our readers will remember, large sums of money were paid by the subscribers to the Motor Company for the control of patents which it was supposed could be obtained. This money having been expended without result by the manager of the Company, it seemed likely that the extraordinary theories put forward by Mr. Keely was destined to fall into oblivion. Indeed, all work in the Keely laboratory had been suspended when, by the munificence of a lady prominently interested in metaphysical science, the means for prosecuting further experiments was supplied. Mr. Keely is also fortunate in having gained the advocacy of that brilliant and persuasive writer H. O. Ward. Where deep-seated opposition is to be overcome it is necessary, if new conceptions are to make headway, that they should be supported by some equally able and eloquent champion. And how much Mr. Keely was in need of a fit exponent of his doctrines may be judged from the following specimens of his own attempts to formulate them. We think that the statements quoted are of much interest in connection with the history of these remarkable speculations. Keely writes :—

"That tuning forks can be so constructed as to show coincident or concordant association with each other, is but a very weak illustration of the fact which governs pure acoustic assimilation. The best only approach a condition of about a fortieth, as regards pure, attractive and propulsive receptiveness. By differentiating them to concordant thirds, they induce a condition of molecular bombardment between themselves, by alternate changes of long and short waves of sympathy. Bells rung in vacuo liberate the same number of corpuscles, and at the same velocity as those surrounded by a normal atmosphere, and hence the same acoustic force attending them, but are inaudible from the fact that, in vacuo, the molecular volume is reduced. Every gaseous molecule is a resonator of itself, and is sensitive to any and all sounds induced, whether concordant or discordant."

" The action of Nature's sympathetic flows regulates the differential oscillatory range of motion of the planetary masses as regards their approach toward and recession from each other. These flows may also be compared to the flow of the magnet which permeates the field, existing between the molecules themselves, sensitising the combined neutral centres of the molecules without disturbing, in the least, the visible molecular mass itself. In the planetary masses—balanced as it were in the scales of universal space, floating like soap-bubbles in a field of atmospheric air, the concentration of these sympathetic streams evolves the universal power which moves them in their oscillating range of motion to and from each other. This sympathetic triple stream focalises and defocalises on the neutrals of all such masses; polarising and depolarising, positive and negative action; planetary rotation, etc., etc. It is thus that all the conditions governing light, heat, life, vegetation, motion, are all derived from the velocity of the positive and negative interchange of celestial sympathy with the terrestrial."

" Every harmonions condition of Nature's evolutions is governed by one incontrovertible law—that of concordant assimilative harmony. This concordant key is the ruling one over all the antagonistic, negative, discordant ones; the one that diverts the disturbance of sympathetic equilibrium to one general concentrative centre for redistribution. Harmony concentrates, harmony distributes. The focalising point of concordant sympathetic concentration is the percussive electric field, where the velocity of its sympathetic streams rebounds with a power that throws them far out into universal space; and so far beyond their equative centre of equilibrium as to bring them in sympathy with the universal attraction of the combined neutral centres of all planetary masses."

" The positive vibrations are the radiating or propulsive; the negative vibrations are the ones that are attracted towards the neutral centre. The action of the magnetic flow is dual in its evolutions, both attractive and propulsive. The sound vibrations of themselves have no power whatever to induce dissociation, even in its lowest form. Certain differential, dual, triple, and quadrupal chords give introductory impulses which excite an action on molecular masses, liquid and gaseous, that increase their range of molecular motion, and put them in that receptive state for sympathetic vibratory interchange which favours molecular disintegration: then, as I have shown, the diatonic enharmonic is brought into play, which further increases the molecular range of motion beyond fifty per cent. of their diameters, when molecular separation takes place, giving the tenuous substance that is necessary to induce progressive subdivision. This molecular gaseous substance, during its evolution, assumes a condition of high rotation in the sphere or tube in which it has been generated, and becomes itself the medium, with the proper exciters, for further progressive dissociation. The exciters include an illuminated revolving prism, condenser, and coloured lenses, with a capped glass tube strong enough to carry a pressure of at least 1,000 lbs. per square inch. To one of these caps a sectional wire of platinum and silver is attached; the other cap is attached to a tube, so screwed to the chamber as to allow it to lead to the neutral centre of said chamber."

" I have been repeatedly urged to repeat my disintegrations of quartz rock; but it has been utterly out of my power to do so. The mechanical device with which I conconducted those experiments was destroyed at the time of the proceedings against me. Its graduation occupied over four years, after which it was operated successfully. It had been originally constructed as an instrument for overcoming gravity; a perfectly graduated scale of that device was accurately registered, a copy of which I kept; I have since built three successive disintegraters set up from that scale, but they did not operate. This peculiar feature remained a paradox to me until I had solved the conditions governing the chords of multiple masses; when this problem ceased to be paradoxical in its character. As I have said, there are no two compound aggregated forms of visible matter that are, or ever can be, so duplicated as to show pure sympathetic concordance one to the other. Hence the necessity of my system of graduation, and of a compound device that will enable anyone to correct the variations that exist in compound molecular structures, or, in other words, to graduate such so as to bring them to a successful operation."

Among the possibilities claimed by Keely are that " From 12 drops of water a force can be developed that will fill a chamber of seven pint volume no less than six times with a pressure of ten tons to the square inch."

"All molecular masses of metal represent in their interstitia molecular spaces incalculable amounts of latent force, which, if awakened and brought into intense vibratory action by the medium of sympathetic liberation, would result in thousands of billions more power in foot-pounds than that necessary to awaken it. The resultant development of any

and all forces is only accomplished by conditions that awaken the latent energy they have carried with them during molecular aggregation. If the latent force that exists in a pound of water could be sympathetically evolved or liberated up to the seventh sub-division or compound-inter-etheric, and could be stored free of rotation, it would be in my estimation sufficient to run the power of the world for a century."

"Suppose," writes Mr. Keely, "that we had just received from the machine shop a spun shell of 12 inches internal diameter, $\frac{1}{32}$ of an inch thick, which represents an atmospheric volume of 904·77 cubic inches. On determination by research we find the shell to be on its resonating volume B flat, and the molecular volume of the metal that the sphere is composed of, B natural. This or any other antagonistic chord, as between the chord mass of the shell and its atmospheric volume, would not interfere, but would come under subservience. We now pass a steel shaft through its centre, $\frac{1}{2}$ inch in diameter, which represents its axial rest. This shaft submits the atmospheric volume of the shell to a certain displacement or reduction, to correct which we first register the chord note of its mass, and find it to be antagonistic to the chord mass of the shell, a certain portion of an octave. This must be corrected. The molecular volume of the shaft must be reduced in volume, either by filing or turning, so as to represent the first B flat chord that is reached by such reduction. When this is done, the first line of interference is neutralised, and the condition of sympathy is as pure between the parts as it was when the globe was minus its axis. There is now introduced on its axis a ring which has seven tubes or graduating resonators, the ring being two-thirds the diameter of the globe, the resonators three inches long and $\frac{3}{4}$ inch diameter, each one to be set on the chord of B flat, which is done by sliding the small diaphragm in the tube to a point that will indicate B flat. This setting then controls the metallic displacement of the metallic combination, as also of the arms necessary to hold the ring and resonators on shaft or axis."

"Thus the second equation is established, both on resonation and displacement. We are now ready to introduce the diatonic scale ring of three octaves which is set at two-thirds of the scale, antagonistic to the chord mass of the globe itself, which is done by graduating every third pin of its scale to B flat thirds, which represent antagonistic thirds to the shell's molecular mass. This antagonism must be thoroughly sensitive to the chord mass of one of the hemispheres of which the globe is composed. The axis of the scale ring must rotate loosely on the globe's shaft without revolving with the globe itself, which it is prevented from doing by being weighted on one side of the ring by a small hollow brass ball, holding about two ounces of lead. The remaining work on the device is finished by painting the interior of the globe, one hemisphere black and one white, and attaching a rubber bulb, such as is used to spray perfume, to the hollow end of the shaft. This bulb equates vibratory undulations, thus preventing an equation of molecular bombardment on its dark side when sympathetically influenced. It is now in condition to denote the sympathetic concordance between living physical organisms, or the receptive transmittive concordance necessary to induce rotation."

We understand that Prof. James Dewar is going to Philadelphia next September to investigate the statements made by Mr. Keely. We are interested to learn this, and hope that the learned professor's visit may result in setting the vexed question at rest for ever—either proving or disproving the possibility of perpetual motion.

PREHISTORIC MONSTER CATS AND DOGS.

There used to be cats in North America 100,000 years ago. Great carnivorous creatures of the feline tribe roamed over the country then in enormous numbers. They are all extinct, and have left only their bones behind to tell the story how they lived and what they fed upon. One often reads of the art by which the naturalist is able to restore the skelton of an animal from a single bone, and in fact a good many mistakes have been made through over-confidence in reconstructing fossils by theory from insufficient material. But there is no possibility of mistaking the testimony afforded by the teeth. They tell all about the manner of existence led by their former owner, giving accurately the habits, diet, and approximate age of the beast.

Thus it is very fortunate that teeth last longer than any other objects in nature. At this day are found in a perfect state of preservation the molars and incisors which were used to chew with by the mighty reptiles of millions of years ago. It is from this dentition that science declares man to be carnivorous only by habit and not by nature. The piercing and cutting of teeth of some of these cats of long ago are the most perfectly adapted instruments for cutting purposes that ever were seen, being unequalled by any manufactured tools for such uses.

For example, there was the "gomphodus," which was as big as the largest panther and had two teeth in its upper jaw resembling daggers, each 5 inches in length. As weapons for penetrating flesh they are unrivalled among carnivorous animals, recent or extinct. They are rather like the teeth of some huge flesh-eating dinosaurs, the "terrible reptiles" of the mesozoic epoch, which had cutting teeth that nothing could resist. Doubtless this creature was inconceivably bloodthirsty. Quite as fierce, however, and even more formidable by reason of its greater size was the contemporary "pogonodon," which was as large as the biggest jaguar. There were two species of this animal which held the field in Oregon during the period of which we speak of against all rivals. It was undoubtedly a great destroyer of life among the herbivorous beasts.

Our knowledge of one of these species is due to a very fortunate chance. Some years ago an exploring party was sent into the John Day River Valley in Oregon for the purpose of looking for fossils. That is a famous region for such treasures, water having cut dig slices out of hills, which were formed originally by detritus deposited during myriads of years. It happened that the attention of one member of the expedition was attracted by something that looked like a skull, half projecting from the summit of the pinnacle of a crag. It was in fact a skull, and the shining of the great teeth was what caught his eye. He climbed up the cliff and brought it down with much difficulty and danger to life and limb. It was the cranium of a once formidable pogonodon.

During this same epoch there were numerous other species of cats, all of them since extinct, which varied in size all the way from that of an household pussy of to-day to the huge sabre-toothed tiger. Not a few of them were astonishly fierce and correspondingly destructive. The teeth they have left behind tell the story of the way they have lived, describing, as well as words could do it, their extreme ferocity. They attained the climax of their type in the sabre-toothed tigers, bigger than either the lion or the tiger of to-day, which had canines a foot in length and shaped like curved knives with saw-like edges. They roamed the continent in the times of the gigantic sloths,

such as the megatheria, and doubtless did much to exterminate the latter helpless and vegetable-eating beasts. They were plentiful in Texas, where the remains of a good many have been dug up.

Unfortunately for them, the specialisation of function was carried so far in their case as to be the means of their destruction. Not only were these exaggerated teeth useless for biting purposes, but they could not be used to cut with unless the animal's jaws were closed. Besides, they were so in the way as to prevent the beast from biting off large pieces of flesh, thus interfering with its feeding. There is reason to believe that sometimes these sabre-teeth got caught in the canines in the lower jaw in such a manner as to hold the mouth wide open and prevent it from being shut again, thus causing starvation. One magnificent skull was found in South America not long ago which had the teeth thus caught, showing that the owner must have perished from this cause. It is interesting to consider the fact that these sabre-toothed tigers—like the cave bears, which were twice as heavy as grizzlies and probably quite as ferocious—were contemporary with human beings on the earth, and the latter were obliged to fight them. Their bones are found in considerable numbers in the caves of southern France, which were the residences of primeval men and women in the ancient stone age, 100,000 years and more ago.

People in those times must have regarded all other creatures as being roughly divided into two classes—those which they could eat, and those which could eat them. The sabre-toothed tiger belonged to both classes, the issue of the conflict in each case determining which ate up the other. With none but the most primitive weapons a man must have had but a poor chance in conflict with such a terrible beast, but probably he depended for overcoming it upon strategem, being acquainted with some sorts of traps and snares. The carvings on bone left behind by these ancient people frequently represent the chase of the mammoth, showing that they did not hesitate to tackle even so enormous a creature.

During the period when the wonderful cats were so plentiful in North America, there were numerous dogs and dog-like beasts also, all of which have since become extinct. The biggest species was as large as a good-sized bear. In that part of the country which is now called Colorado and Dakota there were several kinds of dog-like animals about the size of foxes, which were noctural in their habits, having very large eyes with which to see in the night time. They had great ears also, and short sharp noses. All these things can be told from their skulls. There was a large species of true dog in Nebraska, but comparatively little is known about it, because only very incomplete remains have been discovered up to the present time. Another true dog was the "æluro lon," which had some of the characteristics of the cat. It was abundant in Nebraska, had powerful crushing teeth, and is supposed to have been the ancestor of the hyenas of to-day. Probably it was a scavenger in its habits, devouring the bodies of the antelopes and small camels which then browsed numerously on the plains and in the valleys of this country.

THE INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. 1, price 1s., post free, 1s. 2d.

Or through any Newsagent.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

THE PAST OF THE EARTH.

The processes of Nature are written in an endless cycle. Chemistry teaches us that matter may assume three forms—gaseous, liquid, and solid. Astronomy teaches us that all three of these forms are yet and may be ever present. Geology teaches us the various formations of at least three forms, the liquid, the solid, and the organic, which may be constructed out of either liquid, solid, or gaseous material. Geology cannot say more of gaseous formation than exists in the earth's atmosphere. Astronomy teaches us of other atmospheres, in other bodies, in a state to which we cannot bring our ideas, unless we assume that the earth was once in a condition as we see them to-day on the others—as the sun.

There is no geologic evidence that the earth was ever in the incandescent condition of the sun. It is one thing to show that certain stars and nebula are incandescent, and another to show that the earth was ever in the same condition. No investigation has found a planet in a state of incandescence, or even molten. They are all solid with vaporous nuciei, and gathering their vitality from the energies of the sun, or suns, about them.

The universe is filled with matter—and in all conditions of gaseous, liquid, and solid; and each of the three states are found in all conditions of temperature and pressure. There is no intellect so daring that it may seek beyond the solar system for its facts. While gaseous disassociation of chemical elements are predominant in the sun, we find them nowhere else in the solar system. If it be said in parity that the stars are suns, much like ours, the same parity is justified if one claims that these suns are nearly identical with ours, and have a series of worlds around them like ours. If so, then those worlds are as much like ours as Mars, Jupiter, or Neptune.

The solar system, as interpreted by the spectroscope, shows us nebulous, cometery matter floating through space. These show to us that the gaseous condition is not essential to incandescence, but may exist independently. In fact the phenomena show us that all of the three conditions of matter may exist independently of very high temperatures; that is the same gas that in the sun may have a temperature of 30,000° F. may under other conditions have a temperature of 180 minus. Meteors bring countless millions of ounces daily to the earth, and they have been doing it for countless ages. They bring solids and gases, and both so cold that the frictional impact does not make them incandescent beyond the mere surface. Comets, nearly entirely gaseous, with small solid nuclei, have approached to within a few hundreds of thousands of miles from the sun, without being rendered incandescent, or in other words, without being charged with the solar temperatures sufficiently to reduce them to gaseous form.

We have many times watched the bundle of wires, called an armature, traverse the field of another bundle of wires called the poles, at right angles to it, and wondered wherefore came the amazing forces developed both in the temperature and decomposing effects developed in the modern electric light, or if you please, by transposition, the electro motive force. To say that the force resided in the "magnetic field," and that its exponent was rendered by the armature is to say nothing. It is done that way by some process that breaks up molecular structures. Nature shows a certain thing, existing and acting. It also shows another thing, just as certain, but acted upon. The positive and negative alike depend upon the interactions—that the thing to be acted upon is inert until the thing acting upon it has

changed the first form to one entirely different.

Geologically this is important, although it may seem at first sight merely a problem of chemistry. The astronomer, the chemist, and the geologist, are but links in the chain of nature. That the astronomer should discover masses of incandescent gases, called nebulæ, and that he should find that stars, like suns, should exhibit the same composition in a different condition of temperature and environment is but natural, if we interpret by our knowledge. But facts also discover the same elements in altogether different conditions! How to arrange the discord is the problem. Has any astronomer discovered a single planet—like the earth or Mars, for instance—in any of the conditions assumed by our geologists as a molten or incandescent temperature—not one.

The same geologists assume that the earth was long eons ago a mass of gas wrought up to a solar temperature. "Space" brings no corroboration of such views. All of the matter brought out of space is cold to the 180th degree below zero. If we are gathering up millions of ounces of meteoric dust to-day why should it be impossible that we have gathered up many more millions of the same material in the past? May be that what we are gathering to-day is but a scant remnant of what we have gathered in the long past. The earth may have as well been made out of rich meteor zones as that it is still drawing energy from them.

The earth is growing larger. It has been growing larger for unnumbered ages. When and how it began may be best interpreted from our knowledge of how it is still growing. Of the romote past geology as well as astronomy and chemistry is silent. Neither or none of them tell little beyond the present condition.

There are several well-defined meteor zones through which the earth annually passes, and has been passing since the earth began to grow. It is quite as easy to assume that the earth was formed quite as much out of meteor rings as to assume that it has condensed out of the elements in a gaseous form. Prof. Langly has discovered the presence of water vapour and hydro-carbon gases generally diffused throughout space, but this matter is so endowed with an adherent force of repulsion, that it cannot combine. Our knowledge of the magnet shows us that matter may be so endowed with repulsive energy that it will neither combine chemically nor coalesce by gravity. Siemens has scientifically shown that the sun itself is throwing out quantities of matter into space, probably far beyond the orbit of the earth.

It must be true that the earth has grown enormously from additions of meteoric, vaporous, and gaseous matter. The same phenomena are still proceeding, and are likely to have been more energetic in former ages. But we see but little evidences of it in the earth's crust. The elements in them have been ground up and sifted out, or they have been dissolved and again precipitated. But the principal element in this disintegration was not fire, but water. That the earth has great reservoirs of heat is unquestioned, but it is not necessary for this that we must assume an interior of almost solar temperature, that if it did exist would disassociate all the elements of the earth, and it would become a sun, although a small one.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

ENERGY AND ETHER.

As we look back over the history of mankind and scrutinise the thoughts of the foremost men of each age, we find that from the earliest dawn of intelligence down to the present day, men have speculated on the possible causes of the existence of the world about them. Until a few years ago, until almost within the memory of living men, our race, with few exceptions, has accepted the doctrine of creation as the necessary and satisfactory basis, or explanation, of our existence, the existence of the organised world, and by inference has assumed that the processes of nature being of divine origin were beyond human conception. Within the last two centuries scientific investigation has discovered a great number of natural laws, which after careful study, having been classified and selected, are now the recognised standards of the performance of nature, under given conditions, and form a new basis for speculation on matters concerning which experimental data are unattainable with our present knowledge.

As these natural laws are studied, we find that they show that, under like conditions of cause, the same result is always attained in the same way, or, briefly, they describe the operation of forces in producing results discernible by our intelligence. We are all familiar with the manifestations of force, the various forms of energy, while we have no language with which to make force intelligible to our minds. We speak of electric force, thermic force, gravitational force, mental force, and we mean the ability to perform electric work, the ability to increase or decrease thermic energy, the ability (for reasons still unknown) possessed by bodies of attracting each other, the ability to perform mental operations. We are accustomed to think of these forces as resident in matter, depending upon its physical condition and structure.

The modern views respecting the methods by which these forces act to accomplish the results we are familiar with, are ingeniously outlined by Mr. William Stanley in a very popular and elementary manner, who also defines the conceptions of the medium in which they act, known as the ether.

First, as to the medium; it is very desirable to ascertain if the various forces of nature act to convey each their particular form of energy in the same, or in independent mediums. Is there one medium by which every form of energy is carried, or does each form of energy use an independent path by which to travel?

As in every broad question of this character, experimental evidence at first appears contradictory, for we find that some *substances* convey heat and electricity, some light, and that no two *substances* offer paths of equal freedom to the translation of all forms of energy. For example: if we look at the filament of an incandescent lamp, we see that light emerges from, or is radiated by it in every direction: some medium is conveying light from the filament across the empty space inclosed by the globe, through the glass, across the air to the eye. Whatever the medium may be, it must exist in the vacuous space inclosed by the globe, in the glass, in the air, in the eye, and in fact, *in the brain*: in short, we see that the medium conveying light must exist in the same space as ordinary matter, and must exist in space unoccupied by matter. Suppose now we hold an opaque object, such as a sheet of hard rubber, between a luminous body and ourselves, we find that the light—conveying medium has, so to speak, stopped, or its ability to carry light has been destroyed by the rubber, as no light can reach beyond this boundary line.

We know that a lamp emits heat as well as light; this heat is found on and outside of the glass, and being radiated

across space beyond the bulb to great distances, may be made perceptible by proper instruments. If now we insert a screen of hard rubber between the source of heat and ourselves, and test the decrease of heat caused by the insertion of the screen, we find but little diminution of its power. We learn from these experiments that while hard rubber has the power of stopping the radiation of light, it does not equally stop that of heat, or that while it interferes with the conveying power of a medium which passes along light waves through air or glass, it does not in like manner necessarily interfere with the conveying power of the medium transferring heat.

We might, therefore, imagine that each force, as light, heat, or electricity, was conveyed by a separate medium operative when occluded in certain substances and inoperative in others, or that the various forces possessed some difference requiring specific conditions of universal medium to accommodate their transmission. One of the modern theories of the subject is the outgrowth of a very old conception.

According to this theory, the universe throughout the entire extent is filled full of a something which is called the ether, and which forms the highway over which all energy in whatever form, whether as heat, light, electricity, magnetic or chemical energy, is conveyed. We may imagine an infinite sea of this substance, in which this and all other worlds are sunk or suspended ; such a sea must be considered to be extremely strong or dense, and infinitely elastic. If we conceive of such a medium or substance, we can then form theories describing the methods by which energy is translated from one point to another that appear in accordance with our present knowledge. Of course, the first question such a proposition brings up is how do we move about in an extremely strong or dense substance ? If a man were immersed in solid cast iron he, of course, could not move. To obviate this difficulty, we might imagine the man to be bored full of holes in a certain direction, and imagine also that these holes were occupied by the ether, a very strong substance as iron, then except for the difficulty of turning a corner, our unfortunate friend might travel about passing *through the iron*, while the iron remained stationary. To further help the assumption, we can assume the holes to be infinite in number and extremely small—not as small as the holes in a fine piece of muslin, nor as small as a molecule of which millions would be required to make the extreme point of a needle, but millions of billions of times smaller, so small, in fact, as not only to be for ever indiscernible, but so small as to be undiscoverable by the man.

This gauze-like hypothetical substance then may exist everywhere undiscerned of itself, and may be endowed with all the properties, the assumption of which is necessary for the explanation of the propagation of forces from point to point.

A body or substance of a thing then actually moves through the ether, not between it ; a bird flies through the air by parting it on either side, but passes from place to place in the ether without disturbing or parting it, the ether passing through this moving body as such body moves.

What basis have we for such a conception? Is there any evidence of such an ether, of an ether conveying all sorts of energy, so to speak?

We have seen—in short, we know—that the various forms of energy, light, heat, magnetism, etc., can go from point to point through a vacuum. Magnetism passes through vacua as easily as through air. It is well known that light, heat, electric and magnetic forces reach this earth from the sun. These forces have to pass through vast spaces void of matter. Evidently, then, any medium forming a common path for these energies must be independent of material substance, as we ordinarily understand the term. Now we have experimental data proving that the propagation of light, heat, and electricity is the same : we have tested our ether, and have found that a light, heat, electric, or magnetic impulse travels 186,000 miles per second through the ether in vacuo ; if the transmission takes place through some *substance*—as, for instance, if a light wave be transmitted through a sheet of glass, the speed of transmission is reduced in some way we do not yet understand, and some of the energy of light disappears, taking on the form of energy we call heat. But if, the transmission occur only in vacuo, the distance traversed per second by all the various forms of energy is the same, and this now well-established fact is taken as indicating the existence of but one universal medium.

(To be concluded next week.)

VARIABLE LATITUDE.

Among the most important researches, which astronomers have in hand at present, is an investigation of that period of minute oscillation of the earth's axis which gives rise to the phenomena of variable latitude. At its last meeting in the autumn of 1890, the International Geodetic Union, on the motion of Prof. Foerster, of Berlin, resolved to send an astronomical expedition to Honolulu, for the purpose of making a twelvemonth series of latitude observations, coincident with a like series at the Royal Observatory, Berlin. Dr. Marcuse, of Berlin, and Mr. Preston, of the United States Coast and Geodetic Survey, accordingly went out for this purpose, and the first three months of their work produced substantial results of a most promising character. Upon co-ordinating several hundred determinations of Honolulu latitude with corresponding results at the Berlin Observatory, Dr. Foerster finds that beyond doubt the latitude in Berlin during this period increased by one-third of a second (about thirty feet), and decreased in Honolulu by almost exactly the same amount.

So long ago as 1876, Sir William Thomson, in his Glasgow address, presented a dynamical conclusion that irregular movements of the earth's axis to the extent of a half-second may be produced by the temporary changes of sea level due to meteorological causes, and this striking result of the Honolulu expedition is to be regarded as observational proof of Sir William Thomson's conclusion. It is to be expected that England will co-operate with the other great nations in carrying out the plans of the International Geodetic Union for the most minute investigation of this fundamental problem in astronomy. As a first effort it is proposed to establish four permanent stations for regular and continued observations of this geographical co-ordinate, at points of approximately equal latitude and on meridians about 90 degrees apart. In this way it is hoped to ascertain the cause of these variations of latitude, which have for a long time been suspected at Berlin, Greenwich, and other great observatories, and which could not be wholly attributed to errors of observation. Not only is the research of the first importance in respect to the fundamental observational work in astronomy, but it has exceeding interest in connection with tidal, meteorological, and geological observations and speculations.

A WALNUT tree, 6½ feet in diameter and 80 feet to the first branch, will be the unique exhibit of a Missouri town at the World's Fair.

SOCIAL SCIENCE.

PECULIARITIES—PERMISSIBLE AND OTHERWISE.

One of the familiar nuisances of modern society is the man with offensive ways, who lacks better qualities to balance and excuse them. His so-called eccentricities are a source of constant irritation to his friends and acquaintances, and he never performs any palliating service. That is to say, his foibles are not merely incidental, but inveterate and all-controlling. There is little or nothing of him but his capacity for the annoyance of those who come in contact with him. He seems to study the art of being disagreeable and of thrusting his idiosyncrasies upon other people with provoking effect. Of course, he is always and everywhere bigoted and self-important. The ego far exceeds the cosmos in his composition. He magnifies himself in a degree that is at once both insolent and preposterous. Under no conditions does he ever consent to suppress or moderate his habitual arrogance for the purpose of giving pleasure or avoiding the infliction of pain. He has no respect for anybody else's opinions or feelings: he does not recognise any obligation of tolerance or courtesy, but assumes the right to say and do what he pleases, regardless of persons or circumstances. In short, his philosophy represents the worst form of selfishness, and his ordinary behaviour invites the reprobation of all intelligent observers.

There is much to be pardoned in the way of personal offensiveness when the man is one of superior ability in any respect. The right of genius to be peculiar is readily admitted, because its sane, useful, and admirable manifestations infinitely transcend and trivialise its objectionable proceedings. Its faults serve in a sense to emphasise its virtues, and we easily forgive them on account of the preponderance of excellence in the characters which they would otherwise discredit. The great man has the privilege of his peculiarities. He is not required to conform to general rules of regularity and propriety. It is hardly too much to say that we like him more for his occasional aberrations, on the theory, perhaps, that he is thus proved to be common clay like the rest of us, notwithstanding his superior special gifts. But there is no such feeling with regard to the offensive performances of the average or inferior man. He is expected, for obvious and consistent reasons, to observe the amenities of life and to regulate his conduct according to the established standard of social and moral correctness. Mediocrity has no right to claim immunity in the matter of departures from the path of rectitude and propriety. It is strictly amenable to the laws and customs which have been adopted for the conservation and promotion of the interests of society as distinguished from the impulses and caprices of the individual. There is no liberty of choice for it, because it has not done anything to command admiration or to justify a tempering of judgment in its behalf.

We have good reason to believe that Shakspeare was a man of loose habits and bad associations, but it is not at all difficult to pardon all of his transgressions in view of his extraordinary service to literature. He had a right to do many things that were forbidden to common men. His genius was a badge of exemption from the precepts and usages by which people of only ordinary intelligence were required to order their lives. The same rule applies to other great authors whose ways were not always conventionally circumspect. They earned the privilege of being a law unto themselves in large measure concerning their personal habits and practices. If they now and then violated a prevailing rule of duty, they had ample warrant for it in the important work that they did for the world. Their faults were but a small part at most of the qualities that went to make up the sum total of their characters. The value of their service was not lessened by their errors of every-day conduct. They were not mastered by their evil tendencies. When they deviated from the line of propriety it was not at the expense of their surpassing ability as literary leaders. They never for a moment lost sight of their professional obligations and opportunities. It was only in the way of diversion that they asserted their independence of existing standards and regulations, and the indulgence belonged to them by reason of their remarkable endowments and achievements. Our indebtedness to them is sufficient to silence all criticism of their offensive transactions.

The abrupt and domineering manners of Dr. Johnson must have been very trying to everybody who made acquaintance with him; but they could be tolerated for the sake of hearing his wise and interesting observations upon men and events. He was not obliged to be courteous and considerate, but had the privilege of being bluff and vexatious because he was a man of signal ability. A man of ordinary talent—a man like Boswell, for instance—would not have been permitted to say so many offensive things without protest and retaliation. The victims of Johnson's satire and malevolence were willing to suffer that he might in such a way find recompense of amusement for the knowledge that he imparted when he was in a more gracious mood. He was not always a growler. His saturnine aspect was a mask that he wore at times to suit the occasion or to please his errant fancy; and there was beneath it under all conditions a vast store of kindness and manliness that atoned for all his rude and ungenerous speeches. His ways were partly due to temperament and partly to affectation. His friends took him as he was, good and ill together, and they were gainers to so large an extent that the defects of his qualities were readily condoned. If there had been nothing in him to forgive there might not have been so much to honour and commend.

Wordsworth had some traits of character that were decidedly unpleasant, but they did not embarrass or disparage his great work as a poet. His egotism was colossal and his stinginess was ridiculous. He boasted that he never read any poetry but his own, and he did not hesitate to stigmatise many famous writers as mere scribblers. Southey was one of his intimate friends, and yet he once said that he "would not give five shillings for all that Southey had ever written." Byron suggested that this remark "rather showed how much he thought of five shillings than how little he thought of Shelley's poetry." He was so penurious that he would not provide food for his visitors without recompense. "If you like to have a cup of tea with us, you are very welcome," he would say, "but if you want any meat, you must pay your board." According to De Quincey, he claimed for himself a monopoly of the right to study, admire, and interpret the aspects of nature, and treated what others said in that relation with indifference and contempt. All this was offensive, but there was excuse for it in the fact that he enriched modern literature with contributions of superior beauty and value. His personal foibles are of no importance in comparison with the faithful and substantial service that he performed in the capacity of a poet and teacher.

We know that Swift's private life was in some respects very culpable, but he was so great in point of intellect that, as Thackeray says, "thinking of him is like thinking of an empire falling," and we forget his frailties in recognition of his genius, with a little reservation of scorn for his shameful treatment of the women who loved and trusted him. Goldsmith was a vagabond, but he wrote "The Deserted Village"

and "The Vicar of Wakefield," and so we do not stop to consider the disagreeable features of his case. Burns was a toper, but his dissipation did not prevent him from making a name which runs like a wild flower over his country. Carlyle was brutally unkind to his wife and guilty of other sins that he should have avoided, but his books plead excuse for him in a way that is practically conclusive. We are bound to concede that these men were all public benefactors, and that it would be wrong to hold them responsible for offences which were peculiar to their organisations, and which they made reparation for in triumphs of marked and permanent profit to the world. They were so constituted that they could not always live up to the best examples of dignity, sobriety, and patience, but they did the work for which they were intended with a degree of fidelity and success that may well be accepted as a full mitigation of their shortcomings. It was their privilege to be erratic, and to snap their fingers at rules designed for the multitude instead of the favourites of the gods. Had they been only penny-a-liners we might properly blame them, but they were literary celebrities, and that makes a great difference. Ordinary restrictions are for ordinary people, and extraordinary persons have the right to ignore them, whatever the severe order of moralists may say to the contrary.

The point lies in the distinction between a man who has a right to be peculiar and one who has not. When an individual of limited ability puts aside the ordinary rules of society and undertakes to invest his personality with artificial importance by being insolent he is simply contemptible. Those rules are made expressly for people of his calibre and there are no circumstances under which he is privileged to disregard them. He is not an exception, but an ordinary person, like those whom he daily meets. The world does not owe him any indulgence, for he had never rendered it any particular service. His own opinion of his merits has yet to be confirmed by a popular verdict. He is blind to the fact that men are rated by accomplished results and not by advertised intentions. If he will do something of striking interest or benefit, then he will be permitted to have eccentricities and to claim suspension of given social laws for his personal gratification ; but he must not look for such a concession so long as he fails to provide a justification of that kind. The community in which he lives and by which he is well known will not take anything for granted concerning his qualifications. He will get credit only in proportion to what he actually performs, and there is no expedient by which he can escape this practical test of his pretensions. His attempts to compel attention and admiration by playing a fantastic part are worse than useless ; they are calculated to provoke derision and to take from him the respect that is allowed even to mediocrity when it is modest, industrious, and respectable.

These peculiar people, who have no right to be peculiar, are found everywhere, and wherever found they are a burden and a nuisance. It is impossible to get along with them upon the terms which are generally accepted in social and business intercourse. They insist that we shall take them as seriously as they take themselves, and that is an absurdity. There is no reason why we should humour their egotism to such an extravagant limit. It is their duty to act like other people. They are only so many atoms in the scheme of society, having no gifts above the average order of intelligence, and, therefore, no privilege of offensiveness in any way. The humblest citizen is their equal, so far as this point is concerned, since it is only to superior ability that singularity of conduct is permissible. Their lofty and intimidating ways do not conceal their pitiful want of noble and useful faculties. The chance to do something praiseworthy is constantly before them, and they persistently neglect it. Their time is all absorbed in the task of nursing and displaying their eccentricities. They answer no better purpose than that of demonstrating how easy it is for a man to think he deserves admiration, when he really ought to be ashamed of his situation.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers.

PRIZES FOR THE WEEK ENDING JUNE 11th.

The senders of the first twelve letters, opened by us on Monday, June 13th, containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, the 13th instant, will receive 10s. each. No letters for this Competition will be opened until the first post on the 13th instant. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page i. Envelopes to be marked respectively, " Puzzle Prize 2s. 6d.," and " Puzzle Prize 10s."

NOTE.

Competitors for the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

*** The Coupon will be found on page i.

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

PERPETUAL MOTION IN A MACHINE. A SCIENTIFIC IMPOSSIBILITY.

GILCHRIST AND NALDRETT.—The discovery of the conservation of energy is one of the greatest discoveries and triumphs of modern science. It is a subject that, when rightly understood, suggests wider and more imaginative thinking than any other scientific fact. Here at least is full room for the profoundest and widest speculation. And, perhaps, there is nothing in the whole range of scientific writing upon which writers are so confused in their own minds, and therefore, produce a like effect in the minds of their readers. A short and clear outline of this subject may, therefore, be of interest. All motion throughout the universe is produced or destroyed, quickened or retarded, increased or lessened, by two indestructible powers of opposite nature to each other—(a) force, (b) energy. Force is that power which every atom contains within itself of attracting one another, binding particle to particle. It is termed cohesion; and in attracting larger bodies and systems together, gravitation. If this force had its entire way, the whole physical phenomena would be an inert mass without movement or life. But energy steps in, and, by causing movement among the particles composing all things, in part defeats cohesion, and in so doing produces vibration, and therefrom heat, electricity, and life. So far as we know at present, the cause of the earth's energy is the sun, which energy is derived from the motion due to a gradual contraction of its mass. This sun motion sets in wave-like agitation the unseen and untested by sense—"ether," that extends through all space, as likewise around each particle of matter, thus setting the whole universe in pulsing throbs. Energy is of two kinds, active and passive, or kinetic and potential. Potential, when stored up ready for work, as a stone lying on a mountain; a clock wound up and not going; a bed of coal; a barrel of gunpowder. Kinetic, when in motion or doing work, as when the stone falls, when the clock goes, when the coal burns, or the powder explodes. The potential passes into the kinetic, and the kinetic into the potential, and the different forms of kinetic pass into each other—motion into heat, heat into electricity, electricity into heat, light, and chemical action. Joule, after numerous and laborious experiments, proved that if a kilogramme of water be dropped from a height of 424 metres, and if its velocity be stopped by the earth, this velocity is converted into heat, sufficient to raise the whole mass one degree centigrade

in temperature And from this was established a mathematical formula of the proportion of energy to work. It is held that matter, force, energy, are indestructible; but Sir William Thomson (Lord Kelvin) has a speculation, soundly based on experimental data, that all physical energy tends to become converted into heat. And that all heat tends to diffuse itself uniformly by conduction and radiation, until all matter shall have acquired the same temperature; in other words, Nature will reach that equilibrium towards which she has been working through such long ages, and in doing so will bring the whole of the physical phenomena, as we know to an end. To convert the perpetual motion of Nature—Thomson says, probably not perpetual—into a perpetual motion machine has been the dream of enthusiasts in all ages, but without success. And it seems very clear why not: for the parts of the machine by its very motion, must wear out in time and require renewing. But, as you say, if you could apply the weight of the air as a motive force to a machine made of ever-enduring, ever-renewing material, then you would accomplish the dream of the past, and put to shame the scientist of to-day, who declares that perpetual motion in a machine is impossible. See our comments on the Keely Motor, page 91.

How to Keep Tadpoles.

Smith.—You should have plenty of fresh water and weeds (algæ, etc.) growing in your aquarium. Tadpoles feed on them until about 10 weeks after hatching, when the tadpole becomes an amphibian, and begins to live on its tail. As the change progresses, and the supply of food afforded by the tail becomes exhausted, the animal will feed on animal matter; and at this stage the tadpole will clean a skeleton beautifully. With this change of diet the animal soon becomes a frog. It is not necessary to change the water unless it becomes too stagnant. If fish are to be kept well in captivity, without need of constantly changing the water, it is necessary that the water should be ærated. The best way of doing this to get a small glass syringe (procurable of any druggist), and three or four times daily to sqirt a little water forcibly into the vessel which contains them. This will carry down a quantity of air bubbles with it, a large proportion of which will be absorbed before they can rsie to the surface. Fish really breathe air and not water; and water from which the air has been exhausted will drown them at once.

Are Swallows Found the Year Through in England?

Chapman.—Martins are observed in England as late as November; and they have been seen within a few days of the winter solstice. The swallow has been observed in England in every month of the year, but its presence from the beginning of December to the middle of March is extremely rare. In that singularly beautiful old work, "The Natural History of Selborne," the writer (Mr. White) remarks on the presence of swallows in winter, and in his quaint simplicity reasons why. Read t if you have not done so. Published in the "*Chandos Classics*" for 1s.

Our Photographic Competition.

S. Watson.—Photographs may be sent in either mounted or unmounted, but we need hardly state that if you take the trouble to mount them you will increase their effect.

Miscellaneous.

Indigestion.—Manual of Swedish drill, based on Ling's system.

Woodhead.—Wear underclothing, which acts as a non-conductor.

Burns.—You had better consult an Optician. Yes.

Rylance.—We cannot answer your question, or meet anyone who knows.

E. P. Smith.—The advertisement pages numbered in Roman numerals can be torn off when binding.

C. F. Stater.—We believe there is no limit to the power of acquiring knowledge under favourable circumstances.

W. E. Lawrence Finny.—The coupon for the Photographic Competition has been published each week. It was omitted, however, through lack of space in the last issue.

John B. Haynes.—The last page of advertisements may be removed for binding purposes without in any way damaging the volume.

J. McWilliams.—We have referred to the articles that you mention. We gather the meaning of the writer to be that what a man has never experienced in thought or action, that magic cannot tell him. In magic, as in other things, real knowledge is limited to what he has experienced. You have knowledge of the teachings of Mr. A. T. Davis, because you have read his books, but if you had never read them, magic could not have given you a knowledge of them except through experience,

W. Lane Sear.—You are surely hypercritical, certainly not altogether accurate, and decidedly cynical.

E. B. Beesley.—The coupon that appears weekly on the cover of Science Siftings is all that is required for the Photographic Competition.

Ninian Gray.—The query you send was answered on page 47 of Science Siftings.

*** We ask the indulgence of those correspondents whose replies are unavoidably held over for want of space.

Prizes for Amateur Photographers.

We include among our readers so many who parctice photography both for pleasure and scientific research, that we have decided to start a series of competitions, which we shall continue throughout the season if the interest is maintained. The first competition will consist of

Six Prizes.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co.) for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A Camera for making eulargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a seperate coupon, firmly attached thereto.

The last day for sending in photographs, slides or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet-street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday June 28th, 1892.

Edwards' Isochromatic Plates and Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. Dallmeyer "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, Limited, 25, NEWMAN STREET, LONDON, W.

SCIENCE SIFTINGS
A CHATTY JOURNAL.
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.* 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

LONDON: SATURDAY, JUNE 11, 1892.

SCIENCE NEWS AND NOTES.

"The proper time to begin the treatment of some diseases is a hundred years before birth."
—OLIVER WENDELL HOLMES.

The Physical Education of Women

is of far more importance to posterity than the mental training. Professor Mosso, the Turinese physiologist, whom we have so frequently quoted in these columns, is of opinion that the former must precede the latter to some considerable extent before the higher culture to which the girl has, in her proper sphere an indefeasible claim, can be safely begun and efficiently prosecuted. The physical substratum of the female organism must be strengthened even earlier in life than in the less precocious case of the boy, if the "*mens sana in corpore sano*"—the grand aim of all education—is to be secured for her.

The Usual Physical Exercises

are not approved by Prof. Mosso. All such demands on muscular activity should be practised in the fresh air—in wet weather under spacious sheds open from side to side and from end to end—if they are not to be made worse than useless. Games—he hints not obscurely at golf—are preferable to the quasi-military exercises hitherto enforced in girls' schools, particularly abroad; and he counsels a return to the orchestral movements of female youth in ancient Greece, by which such noble types of womanhood were attained as are still seen in the Venus of Milo, the Medicean Venus, and the fine Amazon developments on view at the Naples Museum. The craniological test will show that in these cases muscular development and grace were not purchased at the expense of cerebral form—their healthier, more symmetrical bodies involving no disproportionate diminution or premature arrest of brain. Subject to a physical education which in no case omits the possibility of her having ere long to undergo the maternal ordeal—the condition precedent of healthy progeny and normal race-production—woman, in Prof. Mosso's opinion, has her sphere of mental activity not less marked, not less imperative, than man, though in her case it is the moral rather than the purely intellectual side that must come most largely into play.

Given a Girlhood so Developed

and invigorated by bodily exercise normally pursued—a girlhood in which anæmic, neurotic, or musculo-degenerative perversions, fatal to sound maternity, are guarded against, there is no limit to be placed, according to Prof. Mosso, on the mental education or professional acquisition that must fit her for her beneficent part in the social organism. Where eccentric aspiration may induce her to attempt the work of the male sex, experience rather than antecedent prohibition will put the more effective veto, her success in such a line, when attained at all, being of so exceptional a kind as to yield no incentive to imitation. The truth is, education, as opened up to woman, is in its initial and tentative stage, when all manner of vagaries are to be expected—vagaries, when not artificially encouraged, best left to cure themselves. As our contemporary, the *Lancet*, points out, within the next generation experience will have taught its salutary, irrefragable lessons, and we shall find woman concentrating her energies and her newly-acquired culture on paths she is best fitted to tread, leaving man to those in which nature and Providence have prescribed him his proper work.

The Vexed Question of Alcoholism

is as fiercely disputed to-day as ever, not alone by laymen, but it is one of those matters over which even doctors differ. One day we hear of some eminent practitioner having emptied a magnificent cellar of wine into the sewers, and the next day comes an appeal from the local hospital for a fund to provide wine as nourishment for the patients. It is not surprising that the public mind is a little unsettled as to the merits of the question when the opinions of the authorities are so conflicting. We only refer to the matter here because of a most interesting canvass that has been made among the physicians of New York. Every practitioner was asked to reply to the question, "Is the moderate use of wine and beer injurious to the health of grown persons?" There are 2,900 physicians practising in New York City, and out of these only 675 replied. The answers are described under the following heads—negative 435, semi-negative 88, affirmative 152—that is, that the largest number do not believe that the moderate use of wine and beer is injurious to the health of grown persons. There is every variety of opinion and every qualification of opinion expressed. Thus one gentleman thinks that no alcohol should be allowed under any circumstances, except on the advice of at least two physicians. This same gentleman adds: "I would not advise with any physician that I knew was in the habit of drinking wine or beer habitually." On the other hand, a physician, nearly eighty years of age, has taken wine from his childhood, and says: "I was well acquainted in Hungary with a physician 106 years old who was able to visit patients and give a very good lecture on materia medica. He drank wine twice daily, eight ounces each time, and I have heard him say many times that without wine he would not live a minute. These opinions, so diametrically opposed, are quite valueless. Men will continue the habit that suits them best until something more accordant is laid down.

The Microscope

has revealed many marvellous things to man, but few more interesting than the actions of the organisms to be found in the blood, when the body is labouring under abnormal conditions. Malarial poisoning has just afforded Dr. P. Hehir some excellent ground for investigation. The micro-organisms were merely varieties, it would seem, of one polymorphic hæmatozoon, and the most frequent and constant of them was a simple spheroidal organism, this being present in all stages of the disease. They were developed within, and set free from, the red blood corpuscles. There was also a small amœboid organism, provided with flagellated very rapidly vibrating processes. Another most peculiar form noticed was the hæmatomonas malariæ stellata, a spherical body with from three to six well-marked cilia-like processes.

The Mode of Destruction of the Parasite

by phagocytes is very interesting; and, as Dr. Hehir remarks, "In malarial blood, phagocytes are often very industrious scavengers, clearing the blood of all stray particles and other foreign agents met with. . . . The rapidity with which they eat up the organisms sometimes prevents the process being properly studied." The notes of one observation are as follows:—"The phagocyte at first advanced towards its victim, and then for about ten seconds appeared inactive, barely touching its prey, and almost suggesting that it had come to make friends with the unwary parasite, reminding one of the spider and the fly. That portion of parasite in contact with the leucocyte was apparently stationary, whilst the free part was making efforts to set itself free, but gradually its movements became imperceptible. The phagocyte continued to entangle its prey until, within the space of a minute, it completely incorporated the amœboid parasite within its protoplasmic web, whence there was no exit."

The Survival of Ancestral Traits

has been engaging the attention of a correspondent, who has made some interesting observations while studying infant life. The toes of the new-born babe are proportionately longer and more flexible than are those of the adult, and instinctively close around the finger or any object not cold enough to repel them which may be placed under them, thus approaching somewhat the type of a probable tree-climbing ancestor. But still earlier ancestry is strikingly suggested by the nails of the young infant. The long, tapered, and curved finger-nails, so commonly considered refined, at this age exhibit a degree of elegance leaving nothing to be desired. Should the transformation in this feature after birth proceed at the same rate that it now does, but in the inverse direction, the results might startle those who pursue nail culture as a fine art. It is not uncommon to see the growth of nail beyond the new baby's finger so long and so sharply curved that the lateral edges almost meet, showing a decided resemblance to a claw. This is most particularly the case with the little finger, which maintains the same degree of difference from the others as may be observed on the hand of the adult. We have never seen an exception in persons of any age but that the nail of the little finger—the *least used* of all the fingers—most nearly approaches (probably retains through neglect) the proportions of a claw. The third finger (not counting the thumb) commonly shows an intermediate degree of form and service. What in ancestral habit or condition will account for the *position* of the infant thumb, which is so peculiar to this age, and so persistent, the thumb being much bent at the first joint, and lying close to the palm of the hand? Apparently it is the last of the five fingers to yield to the will of the babe in grasping things, acting rather as an obstruction than a help for six, seven, or eight months.

The New Flying Machine

that is under process of construction by Mr. Maxim has aroused much interest coupled with scepticism. This is what the inventor writes with regards to his idea:—"In the machine which I am building, and which is intended for free flight, the most intricate part of the whole thing is the apparatus for keeping the machine on an even keel while flying. This apparatus does for the machine what the brain does for the bird. The least deflection from a predetermined angle instantly applies an enormous amount of energy to the planes of the machine, changing the angles of some in order to maintain the angles of others. The machine consists of one very large plane with smaller ones attached to it. I do not anticipate any insurmountable trouble in the direction of maintaining the principal plane of my machine at any angle desired. My apprehensions at the present time are altogether of another kind: Will my engines be strong enough? With the data and formulæ which I have at hand, it would appear that they are, and with a large margin of energy to spare; but the machine is very much larger than any that has ever been made before, and possibly there may be another and an unknown factor—the factor of size." For the sake of overcrowded humanity we hope Mr. Maxim's efforts will prove successful. A real "change of air" would be greatly appreciated.

A Theory of Thunderstorms

is somewhat appropriate at this season. Solids and liquids cannot be charged throughout their substance with static electricity; if charged at all, the electricity is upon their surface. But gases and vapours being composed of myriads of separate particles can receive a bodily charge. The air in a room in which an electric machine is worked is found afterwards to be charged. The clouds are usually charged more or less with electricity, derived probably from evaporation going on at the earth's surface. The minute particles of water floating in the air being better conductors than the air itself become more highly charged. As they fall by gravitation and unite, the strength of their charges increases. Suppose eight small drops to join into one. That one will have eight times the quanity of electricity distributed over the surface of a single sphere of twice the radius of the original drops; and its electrical potential will therefore be four times as great.

A Mass of Cloud

may consist of such charged spheriods, and its potential may gradually rise, therefore, by the coalescence of the drops, and the electrification at the lower surface of the clould will become greater and greater, the surface of the earth beneath acting as a condensing plate and becoming inductively charged with the opposite kind of electrification. Presently the difference of potential becomes so great that the intervening strata of air give way under the strain, and a disruptive discharge takes place at the point where the air offers least resistance. This lightning spark, which may be more than a mile in length, discharges only the electricity that has been accumulated at the surface of the cloud, and the other parts of the cloud will now react upon the discharged portion, producing internal attraction and internal discharges. The internal actions thus set up will account

for the usual appearance of a thunder cloud, that it is a well-defined, flat-bottomed mass or cloud which appears at the top to be boiling or heaving up with continual movements.

A Vast Improvement in Artificial Illumination

is promised in the light which Mr. Tesla has been exhibiting. An experiment performed by him before the Royal Institution consists in joining two sheets of tin-foil, one over the lecturer's head, the other on the table, to the poles of the generator. The space between these two sheets immediately became electrified, and a long vacuum-tube waved about in it, without attachment to any conductor, glowed in the darkness like a flaming sword. The experiment was intended to illustrate the possibility of rendering an entire room so electric, by plates in the ceiling or under the floor, that vacuum-bulbs placed anywhere within it would yield a light. Thus we shall be able to fill our rooms with the potentiality of light, and then, by the simple introduction of vacuum-tubes, to obtain any quantity of it. Those who want a daylight without heat will be able to run a vacuum-tube round the whole length of the cornice, and so obtain a diffused illumination of almost any brilliancy. The fact is noticed, in connection with the experiments, that the lecturer stood in an "electrostatic field" capable of illuminating a lamp without wires, and felt nothing. More, he held a vacuum-tube in one hand and touched a "terminal" with the other, a process which made him "the channel for a current of something like fifty thousand volts," and yet did not receive any injury. Most persons, however, will hardly relish the notion of sitting-rooms about which electricity is running wild.

A New Heavenly Constellation

is among the wonders promised by an optical inventor. Strange to say, it is to shine with greatest brilliancy upon the darkest and most cloudy nights, and it will offer for this reason a most attractive and unique study to the diligent astronomer and an object of the deepest interest to the public at large. We might hazard a prediction as to the name that will be given to this new zodiacal sign. It may be ——; but we refrain! We will not intensify the concern with which this momentous question is regarded by certain members of the advertising fraternity. It is, however, an open secret that, conforming to the spirit of the age, this new star cluster of terrestrial signs, variously and beautifully tinted, will at the same time be so diagnosed as to affect a dignified commercial object; that it will be controlled by man, and even forms the subject of letters patent (No. 3755.92). In short, it is to constitute a splendid galaxy of triumphs in science, scenic art, and advertising. Our language is confident; but when we add that a peculiar lens for carrying out the suggestion—for projecting each new star—has been designed by an eminent optician, and that preliminary experiments have already proved amply encouraging to the promoters, we think this language will appear to be well warranted.

The Four Thousand Pounds Prize

announced in Vol. I, p. 199, of SCIENCE SIFTINGS is among the things to be gained, if gained at all, by means of this invention. For without doubt the illumination of the "right side" of the earth by means of radiant geometric patterns, projected with concentrated brightness in an otherwise dark field of atmospheric clouds, forms the most promising of schemes for signalling to hypothetical scientists on Mars and Venus. We would remind our readers of the concluding words of a prize article published in SCIENCE SIFTINGS, of a suggestion that when the cause of gravitation has been discovered, we may be but little removed from the accomplishment of celestial or etheric navigation. The words that we refer to must not be literally interpreted. But as to the possibility of navigating an "ether ship" within certain limits in the solar system, this is a thing that may be seriously considered. And, if we admit that customers for terrestrial products might some day be found upon the other planets, is it not gratifying to reflect that means by which our market prices might be trumpeted through space are now beginning to be understood?

Emu Hunting

recently attracted Dr. E. Ushmer, F.R.G.S., to North Queensland and the desert region known as the North Territory in Australia, from whence he has just returned. "A party of us went up in that far north region," he writes. "We were among the cannibals, who are great in size, being six and a half feet high, and physically perfect. It is a dry, sandy region for the most part. Emus in large numbers are to be found over this territory. We hunted them on horseback, and it was rare sport, for the reason that they can run as fast as a horse, and a very good one at that. We found the catching of emus almost as interesting as coursing, besides having a certain spice of danger about it. An emu can kick as hard as a horse. I have seen men kicked so hard by this vicious bird that their legs were broken. If I had my choice of being kicked by a horse or an emu, I think I would take the horse. The emu stands on one leg and with the other strikes a quick and most paralysing blow. I never would have believed that a bird had such power had I not had ocular evidence of it during this trip. After two or three of our men had suffered from the terrible kicks of these birds we did not venture near them, but, after running our horses till we got close enough, would bring them down with our rifles. We did not approach them till we knew they were dead.

Rain Making

is once more to the fore, and this time an English inventor proposes to outdo the Yankee artillerists by means of a cheap and noiseless method of reducing those capricious things—the clouds—to our subjection. His process resembles that by which Prof. Lodge proposed to extract fog particles and dust from the air, and it is carried out (like a sort of reversal of the celebrated Franklin experiment) by means of wires attached to balloons, through which electricity from a gigantic "influence machine" is conveyed into the clouds. In some cases a single wire will be sufficient; as, for instance, to neutralise the charge and induce the precipitation of a small thunder cloud. The new process bids fair to give rise to much excitement in the agricultural world, since it puts a double-edged weapon into the hands of rival farmers. Not only can every passing cloud be made to give rain in the proper season, but, when desired, the formation of rain can perhaps be retarded, and "by judiciously manipulating your balloon it will be easy to save your own cut hay by precipitating the thunder clouds over your neighbour's fields." We would hardly care to resort to these formidable expedients unless under the protection of an electric gun or other suitable means of warding off terrestrial interposition at the hands of "neighbours."

GLEANINGS OF THE GLOBE.

Tests are being made at Aberdeen on cattle killed by electricity to ascertain if the current has any detrimental effect on the quality of the meat.

There are now over 250,000 words in the English language acknowledged by the best authorities, or about 70,000 more than in the German, French, Spanish, and Italian languages combined.

They appear to be suffering from a plague of mice in Prussia. At Lubbenau it is said that small, reddish-brown mice, have appeared in great numbers in the fields, and are destroying everything. The cats will not touch them.

Oxygen is a gas whose presence is necessary before the phenomenon of burning can take place, and hydrogen is a gas that burns with a pale blue flame, and yet the combination of these two gases forms water, which is the opposing element of fire.

The deepest sounding yet found in the Mediterranean Sea, says a contemporary, was obtained by an Austrian expedition in July, 1891, between Malta and Crete, 14,436 feet. At 22½ miles south-east of this, a sounding of 13,148 feet was taken.

Diet for athletes among the Greeks was a very different thing from that prescribed for our prize fighters. The Greek candidate for a prize at the games was put on a diet of new cheese, dry figs, boiled grain, milk and warm water, but allowed no meat whatever, and on this apparently simple diet, great efficiency in athletic sports was attained.

Prof. Elihu Thompson, in a recent article, states his belief that 130,000 horse-power of 500,000 volts can be transmitted 240 miles through three wires about as large as a good-sized knitting-needle, and, moreover, that this can be sent underground through a small pipe, using only cotton and cheap oil as an insulator.

Some interesting tests with alternating currents and a particular form of magnet have recently been made. Among the experiments shown was one which illustrated a new method of detecting counterfeit coins. A genuine coin, being a good conductor, was held between the poles of the magnet, but a bad coin, not possessing that necessary qualification, immediately dropped when placed in position.

Large-bodied insects should never be sent by post when pinned, without first fastening the bodies so that they cannot break, and thus damage the rest of the specimens in the box. A little cotton drawn out and turned around the pin so that it holds tightly near the thorax, and then brought around the end of the abdomen and again fastened to the pin, will be found sufficient, especially if a few pins are used around the body to prevent its otherwise moving.

Prof. Newcombe, who has for years been connected with the Naval Observatory at Washington, says the only common sense explanation of an earthquake, to his mind, is that down in the bowels of the earth, say from 20 to 100 miles beneath the surface, there is fluid matter, boiling at white heat, which, as it gradually cools, contracts, leaving a space or spaces between it and the solid parts, and the heavy weight of the earth above the vacant places causes the surface to sink, then you have an earthquake.

In consequence of the enormous initial velocity of the bullet in the new Mannlicher rifle, and the resulting friction and wear on the barrel, it has become necessary to devise some means to prevent both of these evils. The manager of the Government Laboratory at Thun, Switzerland, has consequently devised a method of inclosing the leaden bullet in a thin metallic covering, while over this he places a wrapper of specially prepared oleaginous paper, which reduces the wear of the rifle barrel to a minimum, without interfering with the course of the bullet.

Porret observed, that if a strong current is led into certain liquids, as if to electrolyse them, a porous partition being placed between the electrodes, the current mechanically carries part of the liquid through the porous diaphragm, so that the liquid is forced up to a higher level on one side than on the other. This phenomenon, known as electric osmose, is manifest when badly conducting liquids, such as alcohol and bisulphide of carbon, are used. The transfer through the diaphragm takes place in the direction of the current; that is to say, the liquid is higher about the cathode than round the anode.

Only female gnats bite, and the most of them never have the opportunity to taste human blood. The ferocity of the gnat is much exaggerated, for the larger portion of these creatures live on the juice of plants until such time as they themselves furnish food for other insects and small birds. The bite of the gnat would not of itself cause pain were it not for the fact that from the mouth of the gnat a secretion, poisonous in character, is poured into the wound, its effect being to make the blood more fluid so that it can be sucked up by the insect. Most male gnats live but a few hours, and generally take no food after passing into the perfect state.

The so-called glass-snake does not break to pieces at the sight of an enemy, as is commonly supposed, but, like some lizards, throws off its tail in an effort to escape. There are several lizards which, when attacked, for instance, by a bird or predacious animal, will throw off their tails, and the tail flopping up and down on the ground diverts the enemy and thus gives the lizard time to escape. The glass-snake adopts the same trick, and thus frequently saves itself. It is true, however, that the joints of this singular creature are so loosely connected that the snake will be broken to pieces by a blow of a stick, though the idea of a reunion of the broken parts is a superstitious absurdity. The broken joints do not reunite, though a new tail will grow out in a few months if the reptile has received no other injury.

THE INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. 1, price 1s., post free, 1s. 2d.

Or through any Newsagent.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 32.

115.—Why is the new moon crescent-shaped ?

Since the moon is an opaque globe, shining entirely by reflected light, we can only see that hemisphere of her surface which happens to be illuminated, and, of course, only that part of the illuminated hemisphere which is at the time turned towards the earth. At new moon, when the moon is between the earth and the sun, the dark side is towards us. A week later, at the end of the first quarter, half of the illuminated hemisphere is seen, and we have the half-moon, just as we do a week after the full. Between new moon and half moon, during the first and last quarters of the lunation, we see less than half of the illuminated portion, and then have the "crescent" phase. Between half and full moon, during the second and third quarters of the lunation, we see more than half of the moon's illuminated side, and have what is called the "gibbous" phase. Since the terminator, or line which separates the dark portion of the disc from the bright, is always a semi-ellipse, or semi-circle viewed obliquely, the illuminated surface is always made up of a semicircle plus or minus a semi-ellipse. The line joining the cusps is perpendicular to a line directed to the sun; and, of course, the horns themselves are always turned in the opposite direction from the sun.

116.—How large are the drops of water in clouds ?

The average size of the particles of water in a light cloud can be easily estimated (Prof. Tait) from the diameter of the coloured rings, or *coronæ* due to diffraction, which it produces when it covers the sun or moon. These *coronæ* are smaller as the drops are larger; and hence their diminution in radius is an implication of approaching rain. The radius of the innermost coronal ring is very frequently about 15°—the corresponding diameter of the cloud particles being $\frac{1}{13000}$th of an inch.

117.—How far off can ships and other objects be seen at sea ?

When the heights of the observer and of the object observed are equal, the rule is that the diameter of the earth bears the same proportion to the extreme distance of the visible object from the eye as that distance does to the height of the eye above the sea level. Thus, supposing the heights in question to be each ten feet, the limit of visibility would be reached at a distance of about 8 miles. This statement is very nearly correct in average conditions of the atmosphere; but it must be remembered that refraction—a phenomenon to some extent dependent on the hygrometric and barometric condition of the air—is not without interfering influence.

118.—What is the amount of the centrifugal force due to the earth's rotation ?

Calculating by the well-known formula for centrifugal force, and on the assumption of a mean equatorial radius of 3,962 miles, and a sidereal day of 86,164 seconds, it is found that the acceleration of a point on the equator is about ·1116 feet per second. That is to say, about $\frac{1}{289}$th part of the weight of a body is required merely to keep it upon the surface of the earth at the equator, and by this amount its weight will there be diminished as might be indicated by a delicate spring balance, accurately graduated at the pole, where centrifugal force due to the earth's rotation does not exist.

119.—What will be the ultimate fate of the earth-moon system according to the theory of tidal evolution ?

According to Lord Kelvin, the whole frictional effect of the lunar and solar tides will be first to augment the moon's distance from the earth to a maximum, and then to diminish it, till ultimately the moon falls into the earth; and first to diminish, after that to increase, and lastly to diminish again the earth's rotational velocity. Of course, the ultimate fate of the entire solar system, should it continue long enough under existing laws, and not disturbed by meeting with other moving masses in space, will be the falling together of all the planets, with the sun, into one mass, which, although rotating for a time, must in the end come to rest relatively to the surrounding medium.

120.—To what purpose is the spectroscope applied in meteorology ?

Certain dark lines, known as the telluric lines, in the solar spectrum are due to selective absorption by the aqueous vapour in the terrestrial atmosphere. And as the width and intensity of these lines varies in a regular manner with the amount of this aqueous vapour—the amount of vapour corresponding in its turn with the tendency under similar conditions to the production of rain—it is found to be possible to predict almost with certainty, from a strong development of the vapour lines, that rain will fall within from about 3 to 12 hours afterwards. Not only this, but even the progress of that condensation by which the vapour is transformed into drops can be recognised by spectroscopic means. In this case, absorption bands, indicative of the formation of liquid, put in their appearance in the red and infra-red regions of the spectrum. When clouds obscure the sun's rays, as is usually the case when rain is imminent, the scattered light reflected in the sky is found sufficient for the development of these line and band phenomena.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

127.—In what way would the brightness of the sun be affected by the removal of its atmosphere ?

128.—Why is a deep black colour on the sea very often the forerunner of a storm ?

129.—How is digestion effected in animals ?

130.—In what physical condition should artists' colours be to give the best effect.

131.—What is a diffraction spectrum ?

132.—What is the most probable cause of gravitation ?

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

EVOLUTION IN THE FLOWER.

The flower has a special importance to us in studying the life history of the plant, says Professor J. R. Green. It is the indication of its endeavour to discharge the second of the duties of the organism, the preservation of the species or the propagation of the race. It consists of parts whose meaning is only evident when regarded from this point of view. On a stalk there are superposed successive whorls of modified leaves; a conspicuous outer ring, often composed of two sets of leaves, known as sepals and petals, and within this two other whorls, the stamens and pistil. Of these the stamens develop in their club-shaped heads, or anthers, a number of grains of various forms known as pollen, which give rise to what is the male element in reproduction. The pistil or collection of carpels develops the ovules, in which we have the female cell ultimately produced. The problem of reproduction involves the transference of pollen from stamen to carpel in an organism which itself is passive and motionless. The pollen must reach a particular portion of the carpel known as the stigma, which is usually its uppermost part, and here the changes leading to fertilisation are initiated.

It has been found by Darwin and others, in long-continued experiments, that the best offspring is produced when pollen from one flower in applied to the stigma of another flower, either on the same plant or on another plant of the same species. This cross fertilisation, as it is called, has given rise to various curious and interesting mechanisms to secure it.

The original flower was probably one of a very humble type, such a one indeed as we now find on our forest trees. It had no particular colour, and was not conspicuous among the foliage. It produced large quantities of pollen and was often provided only with stamens or with pistil.

It was fertilised by natural agencies, of which the wind was the most usual.

From such a type the various highly coloured, scented, and curiously shaped flowers we now know have been developed.

In the order of such development the aid of the insect world has been prominent. To effect the change from wind fertilisation to insect fertilisation is the initial difficulty. That once effected, various modifications would soon ensue, and those that were advantageous to the plant would be preserved by natural selection.

Now, insects are largely feeders on pollen, and it is easy to see how the vast amount of pollen produced by such a flower would attract an insect to visit it. The successive visits of the insect to various flowers would result in the deposition of pollen from one on the stigma of others, so that the first insect-fertilised or entomophilous flower would arise. It would be in character such as would be due to the influence of quite a short-lipped insect, with a feebly developed sense of colour. We find instances of these still existing, quite simple in structure, wide open, regular in shape, and offering only pollen to the insect, and either white or yellow in colour.

But many flowers offer another attraction than pollen, in the shape of honey. It is not uncommon to find honey secreted by other parts of the plant than the flower. If we suppose that this secretion of honey at some time came to be poured out on the flower, such a flower would have an increased attraction for an insect, and this property, possibly arising accidentally at first, would be perpetuated, and so the nectary come to be regular part of the flower.

A further development would follow in the shape of various mechanisms for the shelter of the honey from rain, and so lead to its being hidden in tubes or spurs, and accessible only to particular insects.

This development, so briefly sketched out, has not proceeded along one line. Many visitors have been attracted by flowers, and each has led to particular modifications. Professor Green considers only two of these, the fly and the bee.

The fly is an insect of a low order of intelligence, shy, and lazy. It is attracted both by pollen and by honey, and the structure of its mouth enables it to eat both of these.

Its peculiar characteristics have led to the development of flowers which secure it in a kind of prison and retain it for a few days, ultimately releasing it. Such are the flowers of aristolochia and arum. In both these the fly enters by pushing past a fringe of hairs, which are set at an angle inclined forward. The insect is by these prevented from going out. The stigmas of the flowers are ready to receive pollen on its entrance, and if it has emerged from another flower it is dusted with pollen, which, as it crawls over the stigmas, it leaves behind it. After a day or two the stigmas in the prison fade, and the anthers ripen and discharge their pollen, with which the visitor becomes coated. At this time the hairs wither and the fly is enabled to escape and to visit other flowers, where the same programme is repeated.

The low intelligince of the fly is taken advantage of by the so-called grass of Parnassus. In this a number of shining knobs are developed in part of the flower near the stamens, and from a distance these look as if coated with honey, and the fly, deceived thereby, visits flower after flower and effects fertilisation.

A higher type of flower visited by flies is seen in Veronica, where honey is hidden in a small tube in the centre of the flower. To reach it the fly is obliged to hold on by the stamens, and in so doing it dusts its body with pollen, which on a visit to another flower is deposited in the stigma, this being so placed as to touch the insect before the stamens do.

The conspicuousness, however, which first attracted the fly also attracted other insects, whose visits did not always lead to the desired end. Even highly organised flowers still suffer from this disadvantage. The flowers of the columbine, oxlip, and bean are still visited by short-tongued bees, which cannot reach their honey in the legitimate fashion. These bite holes in the petals and steal it without benefiting the flower.

We have to look to this fact for the explanation of arrangements to protect the flower from these depredators. We have these seen best in the so-called bee flowers.

Bees, as a class of insects, are characterised by more intelligence and greater industry than flies. They have a higher colour sense and a more complex mouth. With these endowments we co-relate the fact that, unlike flies, they store up food for their young. Some of the more interesting types of bee flower are seen in the leguminosæ, where elaborate mechanisms lead to the dusting of the visitor with pollen on the part of his body to which the stigma of the next flower must be applied. In lotus the pollen is forced out of the flower by a sort of piston, made of the dilated ends of some of the stamens. This is made to work by the weight of the bee when it alights upon the flower. In the broom the same effect is secured by a sort of explosion, which takes place when the bee commences its search for the honey of the flower.

In the violet a curious cup-like hinged projection has been developed, which opens as the tongue of the bee, coated with foreign pollen, passes down the tube of the flower, but closes and covers up the stigma, when it is withdrawn carrying pollen from the flower's own stamens.

In the barberry and in the cornflower the stamens have become endowed with a peculiar irritability, which subserves the same purpose of dusting the visitor with pollen.

In Salvia, the sage, a curious modification of part of the stamen into a level leads to the pollen falling on to the back of the bee, where the stigma of the next flower visited finds it.

The various forms of orchids introduce us to still more elaborate mechanism, rendering fertilisation without insect aid impossible.

The development of colour in flowers and the explanation of the various markings on the petals must be studied also in connection with insect life.

Probably white and yellow flowers were the earliest, the first distinction being drawn thereby between flower and foliage. These were visited probably by lowly forms of insects, as they are to-day. When honey began to be secreted and hidden, more distinctiveness was needed, and the insects with a high colour sense became the agents of further modification. The markings on the petals, usually straight lines or rows of dots, pointed the insect to the part where the treasure lay. So the development of blues and reds accompanied the evolution of the elaborate mechanisms already described.

Of lower forms, with easily accessible honey, Muller has shown sixty per cent. are visited by flies, as against three per cent. by bees, while of reds and blues it can be noted that the reverse obtains. Flies visit yellow or white flowers more than twice as frequently as red or blue ones.

THE SENSE OF SMELL.

When primitive man ranged his primeval forests at a period of which even our vastly learned modern paleontologists can teach us but little, he was dependent in a like degree with all the other members of the animal kingdom on his senses. Not as we understand this dependence in our advanced day, but as the preying and preyed-upon denizens of untrodden forests in their instinctive struggles for self-preservation may comprehend it. That the senses of man were developed in a degree considerably beyond that of other animals is proven by man's survival. For the senses—particularly hearing, seeing, and smelling—were some of the weapons of early creation, and the best equipped naturally survived by reason of fitness to conquer.

Not the least important of all the senses was that of smell. We can perceive, from the use made of it by the animals with which we are acquainted, of what utility smell must have been to early man, both in tracking out his prey and his enemy and in evading the latter. This sense is, in short, peculiarly adapted to the preservation of animal existence. But since man has abandoned his wild and nomadic habits, for those more suited to his improved condition, his power of smelling has become comparatively extinct. It has accommodated itself to the exigencies of life in towns. Nomadic races, we know, cannot live in cities. The Arabs, for instance, who possess the sense in a most acute degree, are said to continue their wandering life, notwithstanding that the more intelligent fully appreciate the beauties of a restful existence, because of the nauseous exhalations that are perceptible to their acute faculties in towns.

It is interesting to inquire how much of this sense remains to us. Among semi-civilised and barbarous peoples it is still as potent as ever. We have already mentioned the Arabs, and a well-known traveller in speaking of the power of smelling in a Turkoman, says that he can not alone smell a strange caravan when many hours distant, but also specify by the same sense the particular tribe that composes it. The aborigines of America, Africa, and particularly those of Australia, are also notoriously well endowed with this, to them, useful faculty, but to civilised man the nose has fortunately ceased to be an organ of such great utility and only remains as an organ of pleasure. It should be mentioned that this is, however, no complete distinction from the brute, for in the case of many animals we possess sure indications that pleasing perfumes are found grateful. The horse, for instance, rarely receives credit for possessing delicacy of scent. Horse trainers are, however, aware of the fact, and make use of their knowledge in training stubborn and apparently intractable animals. Many trainers have favourite perfumes, the composition of which they keep a secret, and it is the possession of this means of appealing to the horse's æstheticism that enables so many of them to accomplish such wonderful results.

So we see that man's sense of smell has only survived in so far as it is capable of giving pleasure. This fact is also common to a great extent with the other senses. The philosophy of natural selection shows us that man throws off all that is unsuited to his changing condition, in order, no doubt, that he may assume other powers more useful to him. This is exactly what he has done with his sense of smell. He has only retained the pleasurable and discarded the useful. The changed shape of the nostril in civilised man allows only of the exposure of a more limited olfactory nerve-covered surface, hence his indifference to the noxious odours consequent on the crowding of life. He is still sensitive to the pleasing perfumes of nature, and it is no doubt the absence of these in city life that has caused him to imitate them and raise up a "Rimmel" to himself.

Viewed in this aspect it is surprising how much the nose has to do with the conditions of nineteenth century life. In the civilised as in the wild state the nose classifies all odours as repellant or attractive, and it is in the manufacture of the latter that the perfume maker exercises such a potency over town-bred people. His subtle scents possess a fascination for most people, especially when the appetite has once been whetted, that is only comparable to the charm that music has for the ear. It is as much the food of the sense of smell as harmony is of the hearing. The sensuous languor of many delicate scents has before now been responsible for the creation of tender bonds of friendship both in man and in woman. It repels grossness, and is calculated to bring out all that is refined and harmonious in human nature. Delicate perfumes are as physically wholesome as any sense food we can purvey, and the moral ecstacy derivable from them is often appreciated most by those whose senses are dulled to music. Thus has a gross function, once nearly as low in order as taste, become an ideal sense in that incarnation of the æsthetic—man in the steam age.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.

Or from Messrs. W. H. Smith & Son, E. J. Stoneham,

and through any Newsagent.

SEX IN EDUCATION.

We fear some of our readers have not quite appreciated the trend of our comments on the question, "Should Women be Educated?" We have nothing to do with the social aspect of the matter, except as regards wasted energy, time, and money, and the deleterious effect that the lowering of the female and womanly standard must have on the community at large. What we have decried is that women should be forced, like hot-house plants, and put to the performance of certain tasks that have been found possible by men by reason of their special physical fitness, but which must always be beyond the normal power of woman, owing to her very different physical organisation. Weight of brain, as has been clearly mentioned by us, has something to do with the superior powers of man in this direction, although this must be qualified by convolutial arrangement. We mention this fact because in a letter we have received from Mrs. Maria J. Salès, an assistant of the Sydenham Ward of the Woman's Liberal Association, special emphasis is laid on the brain weight of man being inferior to that of the elephant. However, it is practically in another direction that Mrs. Salès rises as the champion of womankind.

We publish her remarks, although we cannot agree with many of the arguments advanced, especially where it is laid down that the failing of women in certain departments is due to neglected culture. Our correspondent says :—"It is quite a mistake to suppose that girls have had more educational opportunities of qualifying themselves as musical composers than men—not one girl in 500 who has been taught music has ever learned thorough base, while every boy brought up to adopt music as a profession *is* taught this, and no one ever became a composer of note without. Mozart, for example, learnt thorough base (which is a most abstruse study) for eleven years before he composed anything. It is the same thing with cooking; most of the best cooks have been men, because whenever the parents of a *man* destine him to be a musician or a cook, they think it worth while to give him a thorough education in his art, as otherwise he could gain much more in some of the numerous avocations open to men (but not open to women), while a girl is expected to be able to cook merely because she is a woman, and to be able to play sufficiently to get married; and parents will not spend so much on girls' education because they hope to get them provided for by marriage. For the same reason, a man never takes to music or cooking unless he has a *special* taste or talent for them, so that the few males who receive a good education in these arts are, to begin with, a picked class, while the numerous female pupils are not so.

"It is equally false to say that women (notwithstanding all their discouragements and disadvantages) are "*nowhere*" as musicians. It is now known from the biography of Mendlessohn that the most beautiful of his "Lieder ohne worte" were composed by his sister Fanny, but that they were palmed off as her brother's, because at that time it was still considered a kind of disgrace for any woman to appear before the public even as a composer. Up to the end of the eighteenth century, in Spain, it was considered a disgrace for a woman to know how to read. Now we know, Sir, that encouragement is usually as necessary to genius as the sun to flowers, proved by the fact that as surely as ever there has been a sovereign who has encouraged and appreciated genius, a galaxy of them has immediately sprung up around that throne. It is also certain that conditions of freedom are equally necessary to the development of genius, and women have always been more or less enslaved up to this time. Let me also remind your writer that up to within the last two centuries *men* were almost "*nowhere*" as composers; no doubt because their enslaved conditions up to that time corresponded to a great extent to those of women up to the present time.

"Let it be remembered that out of the *very few women* who have entered the English universities, Miss Ramsay, at Oxford, and Miss Fawcett, at Cambridge, have beaten all the pick of the men who have passed through for centuries; it is therefore simply a ridiculous impertinence on the part of your writer to insinuate that the intellectual sphere is specially that of man. Another injustice I have to notice is that in your last number it was stated as a proof of this that the average weight of males' brains was greater than that of females, but it was not stated at the same time, as it ought to be, that the elephant has a far heavier brain than man, and that phrenologists are all agreed that the extra average weight of male brains is caused not by larger intellectual organs, but by larger animal propensities; also that it is firmness of *texture* rather than *size* which gives intelligence.

"I thoroughly agree with Sir J. C. Brown's article against over-education of girls, especially the evils of evening work, but consider it applies the same to boys. It is a statistical fact that of all the female youth who enter the Polytechnic —and to be able to pass the entrance examination they must be the flower of the country—one-third die within ten years after from the severe mental strain coming just at the critical age of puberty; and it is much the same with those youths who pass our English Civil Service Examinations.

"If girls are more injured than boys by over-education, which I doubt, it is probably because their physical education is neglected at the same time, while boys' is not, and also that they are accustomed to wear stays; but let me terminate by saying that Miss Ramsay and Miss Fawcett have sustained no injury to health by their successes. Also that women pass the French examinations for medical and teaching diplomas in larger proportion to their number than male candidates, and with no more injury to health."

THE PROPER WAY TO SIT.

Always sit as far back as possible in the chair, so that the lower end of the spine shall be braced against the back of the seat. If this back is straight, the shoulders will also rest against it; if not, they will have no point of support, and it will be found that they do not need it. This position makes no strain upon the ligaments of the spine. It allows a proper position of the shoulders, consequently of the chest, consequently of the lungs, stomach, and every other organ of the body.

Their work is carried on naturally and comfortably, as is also the circulation of the blood, which in a wrong sitting position is seriously interfered with. With the feet resting squarely upon the floor, the hands resting easily upon the lap, perfect equilibrium, and, consequently, perfect rest of the body is secured. There is no strain upon any part of the body; no muscle or organ is required to do more than its legitimate amount of work. The arms should never be folded; for this position not only causes a strain upon the spine, and all the other evils already referred to, but, in addition, places the weight of the arms upon the stomach and the diaphragm, thereby increasing the labour of digestion and respiration. Placing the hands behind the back, or folding the arms behind the back, if possible, is a good attitude to take occasionally, giving as it does, the fullest expansion to the whole upper part of the body.

ENERGY AND ETHER.

The conception of the ether referred to in the first part of this paper requires a property of infinite elasticity. We are familiar with more or less perfect elasticity in various substances, as rubber, ivory, glass, etc., but a perfectly elastic substance is a very different conception. Imagine a billiard ball possessing this property and perfectly elastic block of glass, then, if such a ball could be dropped from any height upon the block in vacuo, it would rebound to exactly the height from which it fell, and it would continue to so rebound for ever, the property of perfect elasticity always restoring to the ball the same energy of position originally given to it. Or conceive a tube of some perfectly elastic substance, say glass, reaching from this earth off through space indefinitely, then if one end of this tube were struck by a hammer the shock would cause a wave or compression to travel outward along its length, which, when once started on its journey, would continue for ever ; imagine the speed of travel of the wave to be 186,000 miles per second, and the simile may be thought to represent the travel or transmission of energy along a tube of ether, each impulse or wave being capable of delivering a certain amount of work dependent upon the force of the initial blow.

Let us for a moment consider the modern picture, conception, or theory, of how forces are transmitted in this assumed ether. Consider a tube of ether capped at each end with some substance ; picture it as consisting of glass or some perfectly elastic substance ; suppose one end of it to be in London and the other in Edinburgh. Call this tube an ether tube. Imagine some mechanical contrivance by which a hammer is made to strike the end of the tube in London with ever-increasing speed ; thus let there be 100 blows on the tube during the first second, 200 blows during the next second, etc., etc. ; the tube will then be expanded at the point of contact with the hammer, that is increased in diameter by an amount depending upon the strength of the blow. As the tube is perfectly elastic, this local swelling or expansion of the tube started in London will travel to Edinburgh at the rate of 186,000 miles per second. Suppose at Edinburgh branch ether tubes are connected to the line, let one such tube join it to a thermometer, another to a man's eye, and another to a bottle containing hydrogen or chlorine. Then as soon as the hammer is started in London ether waves travel through the tube to Edinburgh and traverse the various branch circuits, one of which leads to the thermometer.

As they reach this instrument they will suffer a change, so to speak ; we may think of them as being checked in some manner that causes them to deliver their strain energy as heat which will be registered by the thermometer, the same heat that would have appeared had the hammer struck the solid substance in London. For some time after the starting of the hammer in Edinburgh, the eye connected by the branch ether tube will fail to record any sensation of light, and the gases in the bottle will not combine ; but when the hammering in London becomes extremely rapid, when the number of blows in London exceeds 450 billion per second, the eye at Edinburgh connected by the branch ether tube will discern a faint red light, which, continually increasing in strength and changing in colour with the increasing number of blows in London, will successfully present to the eye all the colours of the spectrum. As the blows approached 750 trillion per second, the blue violet light visible to the eye would fade away into darkness never to be illumined again by the increasing frequency of the ether waves, while the violent chemical combination will take place in the HCl bottle, caused by the combination of these elements in forming HCl.

A plant or leaf connected by another ether tube to the trunk line would also then decompose carbonic acid from the surrounding air and would build up its own structure. During all this time the thermometer first mentioned would continue to register an increasing temperature. As the frequency, or number of blows per second, is further increased, they would undoubtedly perform other work on organised matter, but we have no organs or powers by which to perceive such results. If now at any time during these experiments we have assumed, we could connect a voltmeter to the opposite sides of the trunk line each passing wave sent from London would develop an E.M.F. (electro-motive force) between the opposite sides of the ether tube and would be indicated by the voltmeter ; and again, if we could apply a magnetometer to two other sides of the tube at right angles to the voltmeter connection, the magnetometer would indicate the presence of magnetism as each wave passed by.

We see, then, that the modern theory of the transmission of energy is founded upon the assumption of a universal medium traversed by a wave-like disturbance. If this disturbance be a rapid succession of waves transmitted in a certain direction, so long as these waves do not exceed a certain number of 400 billions per second the entire energy appears to us as heat ; if the frequency of these waves exceeds 400 and is less than 750 billions, they cause the phenomenon we know as light, while the phenomenon of electric strain takes place at right angles to such direction.

Can we then form some theory, described by some simile, that will explain how electricity is conveyed in a conductor ? Let us consider what theory points out as happening when an alternate current generator urges a current over a line. We have assumed in our ether theory that all space and substance is full of ether. Imagine the ether within a copper wire to be somewhat different from the ether outside in the air, and suppose it to be subject to pressures or strains when connected to some mechanical device, and assume that an alternate generator is a device which, when connected to the ether contained in a wire, gives it a peculiar screw-like thrust, first in one and then in the opposite way as each successive E.M.F. is induced in the armature circuit. These ether thrusts then represent the E.M.F. waves of the generator. They cause the ether in the wire to be driven or compressed in the direction of the length of the wire, and this compression may be thought to represent a flow of current. We have seen that the ether thrusts of the generator were screw-like, that is, both rotary and forward. The thrust along the wire corresponding to the pressure or E.M.F. is the forward thrust ; the rotary thrust tends to rotate the ether in the conductor about the axis or centre of the wire.

Of course, the ether in the wire is but a part of, and is directly connected to the ether throughout the rest of the universe. The rotary movement of the ether within the wire must therefore tend to rotate the ether about it. Now we know that the travel of an ether movement is at the rate of 186,000 miles per second, and consequently the ether 186,000 miles away from the wire will receive a rotary impulse or strain one second after the starting of the rotary impulse within the conductor. During this second the rotational effect has progressed through the space mentioned. The transmission of a current or the generation of an E. M. F. along a wire, then, radiates ether waves outward at right angles to the direction of current transmission, and we have

seen that if we get enough of these waves we obtain light. If, therefore, we could make an alternator that would twist the ether within a wire 400 or 500 billion times per second, we should radiate light from the surface of the conductor in every direction, or, briefly, the wire would be luminous.

We may consider a dynamo, then, to be a sort of either hammer or shaker, which sets up a very peculiar and complicated ether motion. When we produce light in a carbon filament we make use of the resistance property of that material, which property seems to consist in a sort of damping of ether waves, transferring such ether motions into motions of the individual molecules of the filament. In fact whenever ether motions take place in *any* substance they set up vibrations of the molecules of that substance, which molecular disturbance is evident to us as heat. Thus some of the waves of the sunlight falling on the window pane are arrested and cause motions among the molecules of glass, which warm it, the glass being able to exercise a sort of selective power, stopping some ether waves and passing on others. All substances exert this power. Those substances which transmit or are transparent to very fast waves, stop or are opaque to slow waves; thus glass is transparent to the short, quick waves of light, and opaque to the long, slow waves of heat, while hard rubber is transparent to the slow heat waves, which are, of course, entirely invisible, and opaque to the fast, quick, visible light waves.

Now our eyes are turned to or respond to ether waves, which occur between 400 and 750 billion times per second. The eye of a cat is tuned to a somewhat lower range. We can imagine an animal whose eye would respond to a very low frequency, so low that the ether waves radiated by an alternate current circuit would excite vision. To such an eye a sheet of hard rubber would appear transparent, our lighting circuits would appear as lines of light, and each stroke of an engine, or each thump of a belt driving a dynamo would cause a flicker in the radiant beams shining from the wire. It is impossible and highly probable that in the future we shall discern the means of producing a sufficient number of alternate currents per second to cause special apparatus through which they are made to pass to glow with waves of light generated without accompanying heat. The investigations of Mr. Tesla and the researches of many investigators make this result probable, and when this time has come, light will be cheapest force at command. We are aware of the difficulties attending the popular treatment of such a subject, and the impossibility of expressing clearly the half understood relations existing between the forces of nature, the ether, and matter. We regard the various forms of energy—heat, light, etc.—as conditions of the ether, the ether something which can be pushed or strained but not materially changed, and matter as something contained in the ether.

A few years ago we were accustomed to associate electricity with a wire and a battery, or a Leyden jar or a something; to-day we believe the wire to be but an incidental instrument in the propagation of energy—a something which makes its presence known through a particular distance or in a particular space. A few years ago we inadvertently conceived that we *made or generated* electricity: to-day we consider that the universe is an infinite sea of energy in which all matter is but incidental, all bodies but temporary or momentary constructions through which or by which this unseen energy may become apparent to our senses.

(Concluded from last week.)

IS THE INTERIOR OF THE EARTH SOLID?

With regard to the article that appeared in SCIENCE SIFTINGS on May 21st, entitled, "The Earth a Shell with a Fluid Filling," and to the query, "Is the Interior of the Earth Solid?" raised in the article, Mr. R. A. Kennedy sends us the following lucid remarks:—

The objections raised by our modern physicists as to the fluidity of the earth's interior are principally, I believe, as follows:—

(1) That the increased density of the strata as we descend would prevent this.

(2) That were the interior of the earth fluid, it would be subject to tides, owing to the moon's attraction, which would be felt at the surface.

(3) The temperature of the earth's crust, though it is found to increase the lower we go, does not do so equally all over the globe.

The first of these objections appears to assume that gravitation is at its maximum at the earth's centre, and, if this were so, the earth's density must be greatest at that spot. But if the interior of the earth is in a gaseous and heated condition, the gravity of the interior could not be proportionately so great as that of the crust (it being known that the denser the object the greater its gravity over an object less dense, though of the same volume), and a body in the gaseous state being more of a repulsive than attractive nature, might it not be the fact that gravity is at its maximum near the crust, or even in the crust itself?

Let us briefly glance at the gaseous theory of the earth's formation. The earth was in a gaseous incandescent state; gradually its heat was given off into space, and eventually a crust began to form round the heated interior. The interior still went on cooling and condensing, and this would leave a vacuum between itself and the crust; nature not allowing a vacuum, however, the crust was forced inwards to fill up the space. This shrinking process would, of course, bring the molecules of the inside part of the crust into a closer union than before, while the pressure of the crust on the interior (if any) would be the same as before. This would explain the reason of the density increasing as we descend.

That the gaseous theory is possible may easily be demonstrated by the illustration of a lava stream which flows white hot from a volcano. The outside soon cools down and forms a hard crust, but the interior retains its heat and fluidity sometimes for a year or more after the eruption.

By this it will be easily understood that the interior of the earth suffers little (if any) pressure from the crust, because the crust formed round the incandescent mass to suit its bulk and shape, in the same way as the lava crust forms on the stream and yet does not prevent its slow movement onwards down the mountain side.

With regard to the second objection as to the internal tides caused by the moon, even if this be the case there is no reason why it should affect the surface. If you take an egg and shake it as hard as you like no effect is observed on the shell; how much less would the slow movement of such a tide be observed on the earth's surface. But if it is admitted that the maximum force of gravity is situated in the crust, then the gaseous interior would settle on it just as naturally as the sea on the outside, but the base being turned to the moon it could have practically no power on it to shift its position.

Thirdly. The different radiating powers of the minerals which compose the earth's crust must surely cause variations in the gradual giving forth of heat from the interior at different parts of the globe.

HABITABLE WORLDS.

When we view the bodies which constitute the solar system, we are prepared to find special adaptations of the familiar substances, with which we are already acquainted, taking the form of the solid, the liquid, the gaseous state under much the same conditions as these elements assume on the earth, and we should have no ground for believing that water would not freeze nor be turned into vapour under the influences of the same temperatures which cause these changes of form in the world around us. But, on the other hand, argued Mr. Alexander Clarke, C.E., in a recent paper, we should have no grounds for assuming that other worlds of our system either had or had not inhabitants merely from the similarity or dissimilarity of any of the conditions of other worlds as compared with our own. Such considerations as the proximity or remoteness from the sun and the consequent increase or decrease of solar heat, the proved presence of great internal heat, the absence of regular seasons like our own, the diminution or increase of the force of gravity, or even the total absence or increased pressure of an atmospheric envelope should form no barriers to the belief of the possibility of other worlds being inhabited.

If our belief in the inhabitability of any world for the abode of rational beings were to be bounded by our own feelings of comfort and adaptability there are even few spots on this earth which we would select as eminently adapted to the development of the human race. There is not a single planet in the solar system in which the conditions of existence are the same as our own. Some are too hot on the surface, as Mercury with its short year of 88 days: some are too hot internally and have too little light and heat from the sun, as Jupiter, where, in its year, twelve times the length of our own, it rolls majestically round the sun continuously wrapped in a vaporous envelope, and so on through the whole solar system. But is it not worth consideration, whether we have not better reason for believing all the planets to be inhabited worlds, than we have for withholding our faith on that subject now, until further light has proved incontestibly the real position of matters, and, further, are we not in a better position for receiving the true revelation if our minds are now inclined to the belief of what to us would, in our present state, show the perfection of wisdom and true adjustment?

Matters may turn out very differently from our hopes, but the highest ideal we can form of a universe would be to think of it as peopled with myriads of differently constituted rational beings, enjoying the infinite gradations of excellence which creative wisdom can devise. It is not satisfactory to our ideas of excellence or perfection to believe that so many great worlds are passing through a period of evolution, or cooling down, and rearrangement so as to fit them in the far distant future to be the abode of created beings, while only one or two of the smaller orbs have as yet reached the stage of habitable worlds, and some of the smallest have even passed this stage and begun to decay. For, after all, from what grounds do we reason in supporting such a theory? Mars has an atmosphere, and has markings which seem to show divisions into land and water, therefore it is or may be inhabited. Jupiter is enveloped in cloud belts, and it is very light in comparison to its bulk. It is too far away from the sun, therefore it is uninhabitable. But Mars is so much further from the sun than the earth that it would only receive half of the earth's light and heat, and the effect of gravity is only half on Mars compared with that on the earth, so that we would require to conceive of great changes in their conditions and surroundings to enable us to picture inhabitants on Mars.

It is true that many compensating advantages are pointed out as to the probability of life on Mars, as compared with Jupiter, but these are all treated as if we were wholly possessed by the thought that human life on earth is the highest ideal, and that the nearer we can perceive these conditions existent in other worlds, the greater will be the probability of the existence of rational beings elsewhere. But why need we puzzle ourselves about the temperature, the gravity, the amount of light, the density of the atmosphere, etc., as if any or all of these were essentials to the existence of rational beings, or as if nature had no plan or method suited for every region.

SHALL WE HAVE RAIN TO-DAY?

Mr. E. Kennedy sends us the following weather chart, of his own compilation. He considers it infallible.

For Bad Weather.

Fair weather will break up when first clouds to appear are cirri high up, which are thin white streaks descending. If rapidly changing into nimbus, which is an uniform black cloud, rain follows.

Cumuli are large white piles of cloud which form about 10 a.m., gradually increase in size, look angry until storm bursts. The larger and whiter the heads the worse the storm.

When cumuli heads resolve their whiteness into black nimbus, wet weather follows.

Cumuli with fine weather of an evening, and S.W. wind, the white heads turn red certain on next day, wind N.E. and wet.

When cumuli pass from white to black with grey clouds passing across, certain cold weather.

Stratus, streaks of grey cloud, when high up and cumuli beneath, a thunderstorm is in progress. Observe its course.

Remarkable clearness of atmosphere always followed by wet.

If sun has a burning sensation early in the morning thunder always follows.

Rain follows if pavement becomes damp without rain.

Rain when sounds are much more distinctly noticed.

Wind after a bright yellow sunset, rain pale yellow.

Rain or wind follow when small black clouds are about.

Rain and wind when small white clouds scud across black masses.

Rain when cirri early morn are white.

Wind will change to the quarter where black oily clouds appear at sunset.

Rain follows a very light clear sunrise.

For Fine Weather.

After rain cloud has passed if cirri are seen.

When cumuli form about 10 a.m., and are distinctly detached like puffs of white smoke, intense heat and fine.

When clouds decrease.

Streaked cirri high up turn crimson at sunrise and disperse.

A dull clear sunrise.

When the sun is cool early in the morning.

When the dew is upon the grass in the morning.

When the sun can be looked at without paining the eyes two hours before setting.

Sun setting in a salmon coloured haze.

A circular red haze low down at sunset, wind E. cool morn; clear hot day; cool evening.

A red moon on rising very cold.

SIFTINGS OF THE STUDY.

Animal Coloration.

By Frank E. Beddard, M.A., F.R.S.E., etc.
(London: Swan Sonnenschein and Co)

In his preface to this work the author states that the volume has grown out of materials collected by him for the "Davis Lectures" delivered during the Spring of 1890. The volume is addressed to persons with no special knowledge of zoology, but having that general interest in the facts and problems of the science, which is now so widely spread. The work is, in our estimation, one of the most comprehensive on the subject hitherto published, and Mr. Beddard has treated it throughout in a most masterly and withal interesting manner. The author takes a dispassionate position upon the disputed point whether the protective colouring both of vertebrate and invertebrate animals is one of design or of natural selection, and the pros and cons are most impartially summed up. In a paragraph dealing with the pigmentation of fish, he assumes that "flat fish, which habitually rest upon one side, are examples of the modifications of colour which have been caused by natural selection, the exposed side is coloured and variable while the underside is white. In the young of the fishes which are symmetrical and swim in the position of a roach or perch, both sides are coloured alike. When the symmetry has been acquired, and the fish has come to lie upon one side, it is believed that the pigment has disappeared from that side on account of its uselessness." In another chapter, dealing with the evidences of protective colouration, Mr. Beddard states that "it is not of course, fatal to the theory that various colour modifications have gradually arisen through elimination to be able to shew that disguises are sometimes seen through and warning colours occasionally disregarded." The chapter dealing with warning colouration in animals is particularly interesting and convincing. Facts, the broad issues of which may have been known to many, are treated in a manner that leave no doubt as to the intricate knowledge the author possesses of every detail of the subject. The work is most handsomely produced, the prints and coloured plates being really excellent and true to nature.

ASTRONOMY AND PHOTOGRAPHY.

The science of astronomy will eventually be destroyed by photography, or, in other words, astronomy will become a mechanical process. In the days when the intricate points of photography were yet to be solved and the amateur picture-taker a thing for future development, it was necessary for a person to be a mathematician of the highest order before he could even claim to be an astronomer. To-day anyone can be a sky-reader who understands photography and the fundamentals of astronomy as taught in the school books. With the aid of photography a person can read the heavens more correctly than of old. He can cover more ground and make more discoveries of unheard of stars and comets. For instance, there are innumerable stars that cannot be seen with the eye even when aided by the most powerful telescope, for the reason that the human eye cannot remain still long enough to pierce the distance and absorb the light of the body beyond, but with a photographic machine, if the absorption does not take place in two hours, the same motionless position can be maintained for four to ten hours, or even longer if necessary. Moreover, distances can be measured by photography in a few hours which formerly occupied an astronomer's time for weeks.

SOCIAL SCIENCE.

CIRCUMSTANTIAL EVIDENCE.

The question of circumstantial evidence is one of the most interesting features of the administration of criminal law. Many of the most important cases turn upon the analysis and adjustment of facts that are indirect and inferential rather than explicit and positive. In murder trials particularly, this aspect of judicial practice is constantly illustrated; and convictions are oftener brought about by such means than by any other. Secrecy is one of the elements of a majority of the homicides. The murderer proceeds in his bloody business with caution and deliberation, taking care to hide the traces of his movements and to make the crime appear to be the work of somebody else. All the resources of cunning and strategy are exhausted in efforts to avert suspicion. The only chance of detection lies in the discovery of circumstances that can be so linked together as to form a reasonable presumption of guilt, and then submit them to the test of those rules of evidence which long experience has proved to be effective. In the absence of eye-witnesses there is no other way to deal with such cases, and justice would invariably be defeated if the Courts were not permitted to take advantage of these opportunities to ascertain the truth with regard to grave offences.

It is to be conceded, however, that circumstantial evidence is always more or less uncertain, and that mistakes are frequently made in accepting it as conclusive proof of guilt. Simple and harmless facts are sometimes susceptible of an injurious construction, and an accused person cannot always explain them in a satisfactory manner. There have been numerous instances of conviction upon such evidence which have turned out to be grievous wrongs. The mere fact of arrest fastens suspicion upon a man to a certain extent, and it is often impossible for him to convince a jury that this suspicion is really nothing more than a conjecture. In theory he is held to be innocent until his guilt is legally established, but practically he is considered guilty until he shows that he is innocent. This reversal of a fundamental principle of law is witnessed every day. The most conservative and charitable people find it easier to condemn a prisoner than to give him the benefit of a doubt. He is at the mercy of every little revelation that may seem to contradict his story. The prosecution ransacks the record of his whole life, and all of his errors and shortcomings count against him, even when they have no actual relation to the particular crime for which he is being tried. He is compelled, in short, to defend himself under conditions that permit no allowance to be made in his favour where there is room for a surmise to his discredit.

There is ample provision, to be sure, for the full and proper presentation of the prisoner's side of the case. He can have competent counsel to protect his interests and to expose the weak places in the evidence and the arguments of the prosecution. It is no longer the practice, as it once was to deny such assistance to accused persons. By the common law of England criminals had no right to be heard by counsel, except as to points of law, until about fifty-five years ago. Before that, all murderers, forgers, and thieves had to defend themselves as best they could without the help of a lawyer. Persons charged with treason were not allowed to have counsel until after the middle of the last century. There was a time when no prisoner was granted process to compel the attendance of witnesses; and if the witnesses came into Court voluntarily they were merely permitted to testify without taking an oath, and little or no credit was given to what

they said. We have rectified these wrongs and introduced rules and methods that afford the prisoner a chance to put all the facts before the jury that can serve to establish his innocence or modify the presumption of his guilt. But it still remains true that the general tendency of the proceedings is unfavourable to him. That is to say, his defence must be complete and unassailable in every particular, or acquittal is out of the question. The degree of circumstantial evidence that is sufficient to send him to prison or the gallows is not sufficient to set him free when it happens to preponderate in his favour. He is required to clear away all doubts and satisfy the jury that there is no plausible reason to believe that he committed the crime; and that is a very difficult task when the evidence is entirely of a circumstantial character.

The answer is to be made, of course, that guilty men often escape, notwithstanding the tendency of the Courts and the public to credit circumstantial evidence against a prisoner. Some of these miscarriages of justice are shameful—and in countries where society is indifferently organised lynch law is frequently invoked to correct them—but they are usually effected by technical pleas that have nothing to do with the evidence.

One case that occurs to us as of modern interest is that of Mrs. Maybrick, who was tried and convicted, it will be remembered, on the charge of having murdered her husband by administering arsenic to him. The evidence was wholly circumstantial and by no means positive in any relation, as was admitted at the time of the trial by many prominent legal authorities. Great stress was laid upon ulterior motives, and although we pass no comment on the fairness of the verdict they were certainly allowed to influence the jury to an extent that was hardly consistent with the theory of legal impartiality. The defence contended that the history of the case pointed away from poisoning as the cause of the man's death, and urged that unless it was definitely proved that he died of arsenic, the question of motive was immaterial. This view was overruled by the Court, but on an investigation of the case the Home Secretary advised her Majesty to commute the capital sentence to penal servitude for life, "inasmuch as although the evidence leads clearly to the conclusion that the prisoner administered and attempted to administer arsenic with intent to murder, yet it does not entirely exclude a reasonable doubt whether the death was in fact caused by the administration of arsenic."

The evidence in this case showed that the physician who attended Mr. Maybrick in his last illness did not observe any of the usual symptoms of arsenical poisoning, and had no suspicion that the patient was suffering from such a cause until the suggestion was made to him. All of the symptoms were consistent, he certified, with congestion of the stomach, not necessarily caused by poison. The day before the man's death another physician who had been called in consultation took a bottle of meat juice from the room and found by the usual test that it yielded a steel-grey deposit, indicative of arsenic. This was the basis of the belief that the man had been poisoned. When the autopsy was made, one-tenth of a grain of arsenic was recovered from the body, or the twentieth part of the smallest fatal dose; and the appearances suggested death from gastritis more than anything else. Nevertheless, the medical experts decided that "there was approximately a *possible* fatal dose of arsenic in the deceased's body at the time of death;" and this theory prevailed with the jury, in spite of proof to the effect that Mr. Maybrick had been in the habit of taking arsenic in his beef-tea and of using other medicines of a poisonous nature, and also that the arsenic might have been taken in merely medicinal doses and at a time considerably preceding either his death or illness.

The whole matter of indirect and technical evidence is a problem which the wisest minds have not been able to solve to their satisfaction. New difficulties are constantly intervening to upset precedents and trivialise rules of practice. The intelligence of criminals is untiring in its search for novel modes of accomplishing its nefarious objects. Cases are daily reported that challenge attention on account of their surprising features, for which no provision is made in the existing system of investigating and analysing given facts for judicial purposes. It is becoming more and more necessary to find additional facilities for discriminating between truth and falsehood in the work of enforcing the laws against offences that antagonise the best interests of society and threaten the security of life and property. The main reliance for the detection of much of the crime of the period is in circumstantial evidence. That is the only source of information in a majority of the murder trials, and the same is to be said relatively of all other prosecutions. The truth cannot be derived from eye-witnesses as often as it must be looked for elsewhere. Therefore it is all-important to devise the best possible methods of establishing guilt or innocence by logical deduction or implication from facts which do not in themselves constitute a complete story. The Courts have no greater duty than that which is imposed upon them in this respect, and the people have a right to demand that it shall be capably and faithfully performed.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealer.

PRIZES FOR THE WEEK ENDING JUNE 11th.

The senders of the first twelve letters, opened by us on Monday, June 13th, containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, the 13th instant, will receive 10s. each. No letters for this Competition will be opened until the first post on the 13th instant. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page ii. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors for the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

*** The Coupon will be found on page ii.

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

DENTAL FILLINGS.

W. H. ROACHE.—White cement suitable for filling teeth can be made by mixing a concentrated solution of mastic in ether with either asbestos or cotton wool. Mixtures of powdered porcelain with plaster of paris, or perhaps with portland cement, can also be used. Pure guttapercha is good.

MOUTHPIECE OF PHONOGRAPH.

A.J. CROSS.—Theoretically the best mouthpiece is a massive metal funnel, polished internally, and having its sides inclined at such an angle as to totally reflect all sound waves moving parallel with the axis of the funnel and throw them forward against the diaphragm situated in the small end thereof. Practically these mouthpieces are moulded in ebonite, like the mouthpieces of telephones. But

there is no reason why you should not turn one up in the lathe—using either ebonite or hard wood of any sort.

About Telegraph Wires.

Puzzled One.—The reason why you see only one main telegraph wire between the poles, but two wires extending from one of the poles into the building, is that one of these two wires is, as you say, "hooked on" to the main, and forms a part thereof. The other wire runs from the instrument in the building to an "earth-plate," *via* the aforesaid telegraph pole. It is more convenient to carry the wire in this way to the "earth-plate" than to lead it directly downwards through the foundations of the building. The electric current flows, if we may be allowed this expression, through the main wire, to the instrument in the building, and thence to the "earth-plate," from whence it finds its way back to the point of origin.

A Home-made Electrical Machine.

F. J. Milne.—Your machine will work better if you replace the brass spindle by one of glass. Use glass uprights or supports also and French polish the woodwork. It is really impossible to tell what other faults the machine may have without seeing it; but we suggest that possibly the varnish you employed may have been made with alcohol containing water. If so, the surface of the varnish will be somewhat matt instead of clear and brilliant as it should be, and it will be very liable to absorb traces of moisture from a damp atmosphere. Did you polish and warm the glasswork before varnishing it? This is important. Another point that you are doubtless aware of is the necessity of a dry atmosphere for the production of long sparks. And it is also desirable that the temperature of the electrical apparatus should be somewhat higher than that of the air with which it is surrounded. You should, therefore, operate the machine upon the hearth very close to a bright fire—albeit the process is scarcely an inviting one in such weather as we are now having. Why not remove the rubbers and transform your instrument into an influence machine?

Cycling *v.* Walking.

A New Subscriber.—The mechanical advantage of a bicycle over the apparatus provided by Nature for travelling on a level is due to the fact that every motion of the animal body involves a considerable loss of energy. In walking, the whole of the body is raised and lowered with every step. If the muscles were so many springs or levers, this up and down motion might be carried on with very little loss of energy. A certain amount of work would be stored up in the act of lowering the body that would be available for raising it again into the former postion. But, as a matter of fact, the muscular action is not thus reversible. Work done in depressing the centre of gravity assumes the form of heat, and is not again available for raising the body. But the bicyclist, although his body rises and falls to some extent, is all the while supported on a spring seat, that fulfils almost perfectly the conditions we have indicated. And even the up and down motion of his legs is rendered mechanically reversible; for the weight of one leg in descending is applied, through the agency of the crank, to raising the other. Hence the velocipede, when it is so constructed as to move sufficiently freely, effects an economy of power that is quite distinct from the convenience afforded by multiplying gear.

Decomposition of Water.

F. W. W.—It is most convenient to use the metric system of measures in making chemical calculations. We will, therefore, state the matter as follows:—1 ampere of electric current is capable of decomposing 5·604 milligrammes of water in a minute. Water consists of 3 parts by weight of oxygen to 1 of hydrogen. A litre of oxygen weighs exactly 1·43028 grammes, and a litre of hydrogen ·179156 grammes. From these figures it may be calculated that 1 ampere of current will liberate about 10·3 cubic centimetres of the mixed gases per minute. 10·3 cubic centimetres is ·0103 litre, and 1 cubic foot is 28·311 litres. Therefore the number of amperes you would require to produce 1 cubic foot of the mixed gases per minute would be 2,749. Note that in this calculation we have assumed what is called the normal temperature and pressure, that being the temperature of 0°C. and the pressure of 760 mm. of mercury.

Miscellaneous.

H. M. Schute.—See the answer to Query 71.

D. Smyth.—Queries addressed to the "Science Queries and Answers" department are not answered in this column unless by special request.

Embryo.—(1) The precipitate is due to oxidation. Remedy: boil the water just before use so as to remove absorbed air. (2) When not specified it is generally to be understood that heating is not necessary to the preparation of the solutions. (3) Let your metallic potassium and sodium be kept covered with naphtha in order to prevent access of air.

*** We ask the indulgence of those correspondents whose replies are again unavoidably held over for want of space.

Prizes for Amateur Photographers.

Prize 1.—A Detective Camera, value £2 2s. (by W. Griffiths & Co.) for the best landscape photograph by an amateur.

Prize 2.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best portrait by an amateur.

Prize 3.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best written definition, of not more than 200 words, of what constitutes a perfect landscape photograph.

Prize 4.—A Detective Camera, value £1 1s. (by W. Griffiths & Co.), for the best definition, of not more than 200 words, of what constitutes a perfect lantern slide.

Prize 5.—A Camera for making enlargements from 12 x 10 plates, value £1 10s. (by W. Griffiths & Co.), for the best lantern slide by an amateur.

Prize 6.—A Handsome Cabinet Burnisher (by C. C. Vevers), for the best photograph (any subject) by an amateur of not more than twelve months' standing—a declaration to this effect must be sent.

RULES.

Competitors may send in any number of photographs, slides, or definitions, but each must be accompanied by a seperate coupon, firmly attached thereto.

The last day for sending in photographs, slides or definitions is Wednesday, June 15th, and they must be addressed to the Editor of "Science Siftings," 78, Fleet-street, E.C., and marked "Photographic Competition."

The photographs and definitions will be adjudicated upon by a competent photographic authority, and the winning prints will remain the property of the proprietors of "Science Siftings."

Unsuccessful competitors requiring their prints returned must enclose the necessary stamps for postage.

The awards will be made known, and the prizes given, on Tuesday June 28th, 1892.

The Coupon will be found inside (at foot) of the last page of cover.

Edwards' Isochromatic Plates and Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. Dallmeyer "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, Limited, 25, NEWMAN STREET, LONDON, W.

SCIENCE SIFTINGS
A CHATTY JOURNAL.
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.* 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, JUNE 18, 1892.

SCIENCE NEWS AND NOTES.

Like leaves on trees the race of man is found,
Now green in youth, now withering on the ground;
Another race the following spring supplies—
They fall successive, and successive rise.
—POPE'S HOMER.

Our Porcelain Portraits

have roused the ire of a photographic contemporary styling itself *The Practical Photographer*. In questionable grammar it expresses "regret to see that one of our contemporaries .... are (*sic*) vigorously advertising two-guinea porcelain enlargements, packed and carriage paid for seven and six. Is it honest journalism?" We have reproduced our contemporary's remarks in order that they may obtain through SCIENCE SIFTINGS the publicity they miss in its own columns. We can well understand the astonishment with which these porcelain portraits are regarded by connoisseurs, for we give for seven-and-six a picture that we challenge any photographer to produce, quality for quality, under two guineas. This, as we have repeatedly stated, is at considerable loss to ourselves, but that is our business, and if we choose to make such readers as avail themselves of our offer a present to the value of about thirty-five shillings, we feel we are doing nothing derogatory to journalism. The impudence of our contemporary is, however, particularly delightful, for the journal in question is owned and published by a photographic firm, and its editor is in the habit—or was, until recently—of personally canvassing for orders for photographic goods on behalf of the firm he represented in a dual capacity. *Hinc illæ lachrymæ!*

The Cure for Blushing

is more often sought after by males than by members of the fair sex. Any general practitioner can certify to the frequency with which he is consulted about this tell-tale phenomenon by men. The physiology of blushing was treated of by us in an early issue, but the subject has now been much more amply dealt with by Dr. Harry Campbell in a book published by Mr. A. K. Lewis. Dr. Campbell terms the symptom a widespread nerve storm, and that is exactly what it is. The author minutely analyses his subject according as (1) it is associated with dilatation of the cutaneous vessels, (2) their contraction, (3) excitation of sweat glands. Thus hot and cold flushes, shivering, perspiration, clammy sweat, are all taken as evidences of a central nerve storm. These dermic phenomena are then carefully traced, and cases cited in which they showed themselves in a varied sequence. Very many of the cases are those of "shy persons," who doubtless—for their name is legion—will be glad to learn that their troublesome complaint has at length been thoroughly investigated, and a special system of treatment introduced. It is somewhat surprising to find a "champion athlete" who "always blushes when he thinks he will 'make a fool of himself.'" Having accepted the glowing cheek of this man of prowess, one is more prepared to find a "mason and builder" who is "timid and despondent," and who "blushes when he is looked at, but not otherwise." Dr. Campbell impresses his readers with the fact that blushing, flushing, and the nerve storms which he associates with these vasomotor disturbances are, after all, symptoms of either a poorly nourished or hereditarily feeble nervous system, or some morbid change attacking a healthy individual. The *Lancet* is of opinion that the treatment of such cases must resolve itself into the cure of the general malady rather than of the symptom or group of symptoms.

A New Disease,

or, anyhow, the new application of a disease, if such an expression be permissible, has been discovered, not by a medical man, but by a legal luminary, who actually secured a doctor to give evidence as to the accuracy of his contention. In the case of a man recently accused of a petty theft it was attempted to show that he was suffering from "locomotor ataxy," which "made him pick up things without knowing it." The diagnosis was doubtless perfectly correct, and the hands of an ataxic may be partially devoid of sensation and of muscular sense, and their movements clumsy and awkward. But the fingers would hardly "drop the parcel into a pocket." In fact, that is just the very thing that an ataxic would not do without a good deal of ill-directed fumbling. The *Lancet* essays to impress on all medical men great circumspection in drawing general conclusions or making specific statements as to the capacity of an individual to perform purposive acts. There are no doubt cases where from the nature of things there may be a conflict of medical testimony. Such examples afford only too readily an opportunity for unmerited scoffing at scientific knowledge.

An Earwig in the Ear

has from time immemorial been considered by the ignorant as a calamity about as dangerous as a bullet wound. As a fact the insect seldom gains access to the auditory canal, and in the event of its doing so, it need be no cause of alarm. The idea that the intruder has propagated its species during its temporary imprisonment, and that henceforth colonies of its progeny are doomed to dwell in and issue forth from the affected organ, could only be entertained by the weak and credulous. However, a foreign body in the ear is by no means comfortable, and may occasionally prove dangerous if clumsy methods are made to

extract it, or if entirely neglected, as in the recent case of a boy who had forced a horse been into his ear, which, after death was found to have sprouted. It is not remarkable that the bean should have sprouted in such a warm and moist cavity. We have heard of a grain of wheat long retained under the upper eyelid germinating, Such phenomena are easily explained by the ordinary laws of nature.

The Evolution of the Human Skull

has just been summed up by Dr. Paul Topinard, of Paris, whose studies in physical anthropology places him in the front ranks of that science. In tracing the transformation of the animal into the human skull, he demonstrates that this change is brought about by the gradual development of the brain, and the resulting mechanical pressure on the hard parts adjacent. The pressure exerted by the enlarging hemispheres on the occipital bone is in a direction backwards and downwards, so that what is its superior surface in ordinary mammals becomes the posterior in man, and its posterior face the inferior. The occipital foramen, instead of looking backwards, is in man turned downwards. The increase in size of the anterior lobes of the hemispheres brings about still greater changes in that portion of the cranium. The orbits are pressed from a lateral into a frontal position, the face, instead of being in front and oblique, becomes vertical, and below the frontal lobes ; and numerous minor alterations in the anatomy of the parts are necessitated by these changes. It is easy to arrange a perfectly graduated series of skulls illustrating this development from the lowest mammals up to man. Next to him are the monkeys, below these are the lemures, and then follow the inferior mammals. Everywhere the principle of harmonic accommodation of organ to function is strikingly shown. Although the general statement of this evolution has been frequently advanced, it has never before received so complete a demonstration.

The Fundamental Question in Anthropology

is that of the causes which have led to the differences in the races of men. Hitherto most writers have been content with surface generalisations about "environment" and "heredity." The disciples of Spencer have rung the changes on these with little positive profit. We have no knowledge what heredity really is, and "environment" has borne more than its share of causality. A real step in advance has been taken by Dr. Dareste, who shows conclusively that monsters or monstrosities are not the result of pathological changes in the embryo, as has hitherto been supposed, but are modifications of the processes of organic evolution, precisely analogous to those which bring about the differences which distinguish individuals and races in mankind. This can be proved experimentally in oviparous animals, the domestic fowl, for instance. By developing the chick in an artificial incubator and subjecting the egg to unusual conditions, such as shaking it from time to time, varnishing it, exposing it to rapid changes of temperature, etc., we can produce monstrosities in all points analagous to those in man. The changes take place in the earliest epochs of embryonic life and are in two directions: (1) arrest of development ; (2) union of homologous parts. The former assures the permanence of an embryonic condition, the latter produces the phenomenon of double monsters. By tracing the conditions which yield these exaggerations, we may distinctly perceive the causes of many of the physical peculiarities of man.

The Dynamo

has been a great source of worry and anxiety to those who have come in contact with it unaccompanied by a non-magnetisable watch—a very difficult thing to obtain. The commonest watches often escape injury altogether, and trouble generally is found in the magnetisation of the balance-wheel of compensated watches. But in low-class watches the compensation is often a mere dummy, and the time-keeping qualities are in no way affected by replacing the balance by a plain one of gold or brass. The hair-spring occasionally gives trouble, and the coils may even stick together after exposure to a strong field ; but a phosphor bronze spring, though difficult to adjust, behaves very well. Alloys of palladium have been used, but manganese steel is obviously the best material for the purpose. The lever also may with advantage be made of manganese steel, but as the ruby pallets prevent metallic contact, it does not give much trouble. In one case a watch that had been magnetised was demagnetised by spinning, and the compensated balance was replaced by a wheel of plain gold. Although the watch contains an unusual amount of steel work in the chronograph motion, it has never been affected since by the proximity to dynamos.

The "Kelvin"

is the new designation that has just been given, with the approval of the Board of Trade and the consent of Sir William Thomson, to the "unit" of one thousand watt-hours. There is some question as to whether any name was needed, and whether the simple term "unit" was not sufficient for all purposes. While Lord Kelvin certainly deserves the honour, and the unit should bear his name, perhaps, in preference to any other, yet there is some ground for the objection to designating electrical units by proper names. The term contains no clue at all to its meaning, and the most learned scientist could not even make a guess at it without some clue. The science is not especially simple now, and it hardly seems advisable to further complicate it by the introduction of terms which convey no intelligent meaning to the average mind.

A Magnetic Telegraph

is described in a little book entitled "Mathematical Entertainments," printed in Holland in 1641—two and a half centuries ago. The name of the author is Wynand. It has the representation of a compass, with magnetic needle, around which are the letters of the alphabet placed instead of the usual points. The writer, after explaining the effect of natural and artificial magnets upon the position of the compass needle, mentions (not as a new idea of his own, but as a suggestion frequently made by others) that by such an arrangement messages could be transmitted, by turning the magnet successively in such positions as to make the compass needle stop, periodically, when pointing at such letters as would spell out the words of the message to be transmitted. There is no doubt that this is perfectly practical for next-door neighbours, but at a distance it would require a very strong magnet. This is what the author considers as the drawback for such a system, and he states that he does not believe that a magnet strong enough to make it practical at a distance could be found or made. He next expresses his fear that such inter-communication at a distance would be very dangerous for the public safety, as it would make all kinds of conspiracies possible, and that it should be forbidden by the Government as soon as it was found to be possible. With our present experience, during the last half-century, that inter-com-

munication at great distances, in place of being dangerous, has been very useful, and has contributed largely to the public safety, the opinions expressed by our ancestors become nowadays simply absurd, and we must wonder at their excessive timidity, which crops out at the introduction of every novelty, be it steamboats, railroads, illuminating gas, and last, but not least, electricity as an illuminator, or as a motive power.

Edison Originated Electrocution

on a practical scale, as we have already mentioned in these columns, when he waged such successful warfare on cockroaches. We are greater believers in the humanity of electricity as a destroying agent when thus applied, than when used punitively for man. We now hear that Edison's original device has been greatly improved upon, and applied to prevent caterpillars from climbing up trees. Alternate wires of copper and zinc are run around the trunk of the tree, at a distance of about half an inch apart. The casual caterpillar begins to mount the trunk of the tree, and unlimbers himself with the confidence and vigour born of an impending feast. Presently he reaches the copper wire, pokes his nose over it, and lets another kink out of his backbone. Half an inch further up his front feet strike the zinc, the circuit is completed, and the unfortunate larva is a martyr to science.

A Useful Hygrometer

may be improvised by the traveller by placing a watch between the sheets of a strange bed and watching for moisture on the glass; but moisture can be more readily detected by the use of a small piece of gelatine, and many nervous travellers carry a little of this with them and always test the sheets with it before going to bed. If a thin sheet of gelatine be laid between the sheets and after five or ten minutes is found to be hard and flat, there is no possible danger; but if it appears sticky after the trial, or if the edges curl up, the traveller had far better sleep in his clothes with a rug around him than undress and get into a bed which he can be certain is sufficiently damp to create pneumonia or one of a dozen similar ailments.

The Land and Water of the Globe

have just been the subjects of some interesting lectures in Boston, delivered by Mr. John Murray, a member of the "Challenger" expedition, and one of the highest living authorities on oceanography. Among many special papers of great value which have been published by Mr. Murray is one relating to "The Height of the Land and the Depth of the Ocean." In this learned monograph it is estimated that the area of the dry land of the globe is 55,000,000 square miles and the area of the ocean 137,200,000 square miles. He estimates the volume of the dry land above the level of the sea at 23,450,000 cubic miles and the volume of the waters of the ocean at 323,800,000 cubic miles. He fixes the mean height of the land above the sea at 2,250 feet, and the mean depth of the whole ocean at 12,480 feet. Of course these results are only approximate, but they help to render our ideas of these matters more definite. In his paper Mr. Murray also estimates that the rivers of the world carry into the ocean every year 2¾ cubic miles of sediment. To this must be added the matter carried to the sea in solution, which is estimated at 1·183 miles of matter. Together, then, the amount of matter carried through the land each year is 3·7 cubic miles. It would thus, according to this calculation, take 6,340,000 years to transport the whole of the solid land down to the sea.

The Charge of Impeding Scientific Progress

has been laid at the door of Electricity by an astronomer, who alleges that the accuracy of astronomical observations is being seriously impaired by the glare from electric street lights. He states that since electric lights have been brought into general use in cities, the difficulty of discovering new nebulæ or faint comets has materially increased, and that the sky illumination fogs the plates in photographic work. He suggests that inventors have now an opportunity of earning the eternal gratitude of astronomers and photographers of celestial scenery by devising some means of overcoming this difficulty. His own idea of a remedy is a means of maintaining the light at one level, and that near the bottom of the globe, during the entire night. If this were done, and the upper half of the globe of the lamp were painted white, he contends that not only would the illumination of the street be improved, but that nine-tenths of the light would be prevented from ascending skyward.

Lepers are Electricity-proof,

if the story related by a correspondent at Honolulu may be credited. He writes:—"I had a battery, and I'd place a gold piece in the bottom of a jar of water connected with the battery. Then I'd tell the native boys that they could have the money, if they'd pick it out of the jar and hold the handle on the other pole of the battery at the same time. Of course, the moment their hands struck the water the circuit was completed, their fingers would be doubled up and they couldn't touch the money if their fortunes had depended on getting it. I had many a laugh, and achieved quite a reputation as a wizard who controlled the devils in the water. One day, when several young ladies were in the office, a lad came in, pushed on by a number of companions who had attempted to secure the money and failed. He had been persuaded to try, and I explained the trick to the ladies in an aside as I arranged the apparatus. The boy took the handle, and we all prepared for a great laugh. He put his hand into the water, slowly drew out my coin, and quietly walked off with it, while I stood with my mouth open, afraid to face those girls, and praying for a volcanic eruption to turn the trend of thought. The boy had the leprosy, and the electricity didn't affect him."

Ammonia for Electric Shock

is a cure advocated by an ingenious dentist, who has been making some interesting experiments with animals which have been nearly killed by electric shocks. One day he was standing in the street and saw a sparrow in a small pool of water. The bird soon went up and flew to a wire overhead. The shock at once sent him to the ground, where he lay until the dentist picked him up, barely able to move his wings. The gentleman breathed into the sparrow's mouth and let him go. As the shock was not a very bad one, the bird was soon able to fly, but he again returned to a dangerous locality, and the result was another shock much worse than the first. When the bird fell to the ground he was apparently lifeless, but the dentist took him to his office and began an experiment. He at first resorted to artificial respiration as before, and then injected in the bird's flesh aromatic spirits of ammonia, and poured a few drops diluted with water down the sparrow's throat. He then put him in a dry closet and gave him some clear water after a few minutes. When placed in the closet the bird's body was nearly cold, but the treatment proved so effective that in less than an hour he was able to fly as well as ever, and was liberated.

GLEANINGS OF THE GLOBE.

Mrs. Sales, whose remarks on "Sex in Education" we published last week, sends us three corrections. In the last paragraph but one "female youth" should have read "French youth who entered the Polytechnic," and in the preceding paragraph "firmness of texture" should have been "fineness." Our correspondent should have been described as President of the Sydenham Ward of the Women's Liberal Association.

A correspondent suggests that, owing to the concentration of electro-static charge in thunder clouds, and the induction of reciprocal charge at the surface of the earth, where such clouds pass over a stormy sea, they should give rise to local electro-friction and self-repulsion at the surface of the water, thus facilitating the breaking and the destructive effect of the waves. Can any reader inform us whether this theory as to local violence of the sea beneath a heavily charged thunder cloud has any confirmation in known facts?

An experiment to protect carrier pigeons from hawks or other birds of prey has just been made by Signor Carlo Andreini, of Florence. He has constructed a very small whistle, which can be fastened under the pigeon's wings, and the sound of which preserves the bird from attack while on its journey. Several birds so protected have made long and successful journeys in Italy. The weight of the whistle being under $3\frac{1}{2}$ grammes (or about one-eighth of an ounce) it does not interfere with the bird's flight.

In a paper on instinctive criminality, Dr. S. A. K. Strahan holds that the criminal belongs to a decaying race, and is only found in families whose other members show signs of degradation; in fact, it is only one of the many signs of family decay. Besides being hereditary, criminality is interchangeable with other degenerate conditions, such as idiocy, epilepsy, suicide, insanity, scrofula, etc; and it is a chance whether the sanity or drunkenness, say of the parent, will appear as such in the child or be transmuted in transmission to one or other of the alternate degenerate conditions.

Professor S. P. Langley, of the Smithsonian Institution, in discussing "Mechanical Flight," remarks:—"It has been said that those who ask attention to a new truth (and a new truth is always looked on with suspicion) find that its public reception passes through three stages. In the first, its advocate is told that his so-called truth is opposed to all that is known, and absurd; in the second, that if proved true, it would be useless; in the third (which is the stage where its ultimate success appears probable), that it has always been known, and that no one needs to be told of it."

Earthquakes may result from other causes than shrinking of the earth's crust, writes Mr. E. Kennedy, and he points out the following:—(1) Large caverns gradually filled with petroleum fired by lightning. (2) Impregnation of earth by explosive gas and air mixed, and fired by lightning or compression. (3) Compressed steam and compressed air. These causes, Mr. Kennedy is of the opinion, must not be confounded with commotion in the bowels of the earth which find exit in volcanoes, and send earth tremors half round the globe. There is, he says, referring to these one continuous earthquake going on all over the world.

A flying machine has been invented by Mr. M. Mahone, living near Northfield, Minn., which, according to the model, is a success. It is about two feet long, the shape of a water vessel—air wheels projecting from the stop and sides resembling those used on a common windmill. The top wheel is to lift the thing from the ground, while the side wheels are to change from a straight course. A clockwork machine manipulates the wheels, being put in operation by a cord pulled by the operator. A test the other day revealed that weight two and a half times that of the machine was carried around the room clear to the ceiling, the rudder wheel working perfectly.

A method of examining the atmosphere in mines is being used at Kolscheid, near Aachen, Germany, in which electricity is employed. Briefly, it is as follows: A gasholder is placed in the chief ventilating shaft, and is so arranged that it becomes filled in twelve hours: in this way it is possible to obtain a fair average sample of the mine air. The air thus collected is examined by means of a Coquillon's grisometer. Any free carbonic acid gas that may be present is absorbed by caustic soda, and its percentage estimated by noting the diminution in bulk. The marsh gas is then decomposed by a platinum wire heated to incandescence by means of an electric current. A further diminution in bulk takes places, and this being observed, the percentage of marsh gas in the pit air can be calculated.

The game of chess takes its name, or rather is supposed to take its name, (for on this matter scholars are not agreed,) from the word Shah, and to checkmate is to shahmate. Its antiquity is not a matter of doubt, for over 5,000 years ago a game was played in Hindostan which did not in any essential point differ from the chess of the present day, save that it was played by four players instead of two. From Hindostan it is supposed to have spread west of Persia, thence to Arabia and was carried by the Arabs through Africa to Spain, whence it soon spread over Europe. This is the common account of its journeying, but it is nevertheless a fact that the game was known in England long before the Norman Conquest, and chessmen of ivory, bone and metal, dating, it is believed, from the Roman occupation of the island, have been found in England, Scotland, and Ireland.

It is a mistake to suppose there is any warmth in clothes. Animal heat is the direct result of changes going on within the body itself. Nutrition by food and the discharge of energy by exercise are the efficient causes of heat. Clothes "seem" good and warm because they prevent the cold air and objects with a capacity for heat which surround the body from attracting the heat generated with its organism. The clothing is simply an insulator. It follows that it should be light in weight, and above all things that it should permit free and full circulation of blood through every part of the system—to the end of finger and toe—and that the muscular apparatus of the extremities should be in perfect working order. If we will wear foot covering, whether boots or stockings, which compress the feet and render the separate action of each toe impossible, it is simply absurd to expect to be warm-footed. Heat is the complement of work and nutrition, and if a part of the organism is so bound that it cannot work and its supply of food is limited it must be cold. The resort to stouter and heavier clothing under such circumstances is simply ridiculous. Generally it is the stocking that compresses the foot. The garter acts as a ligature, and diminishes the blood supply, while the stocking itself acts as a bandage and impedes the circulation throughout the extremities.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 33.

121.—Why does a shower of rain calm troubled water ?

The rain drops produce vortex rings partaking of the motion of the surface, and these rings travelling downwards (owing to the downward velocity of the rain drop) are carried into regions of comparative stillness, and moderate the turbulence of the water by equalising the distribution of its momentum, equalising, that is to say, the distribution of the energy involved in local movements of the fluid.

122.—What is the meaning of lap and lead in a steam engine ?

Lap is an overlapping of the steam ports by the ends of the slide valve when this is in its central position on the valve seat. The admission of steam begins only when the displacement of the valve from its middle position exceeds the amount of this lap. Hence its effect is to shorten the period of admission of steam, and to allow time and space for the dilatation of that which has been admitted into the cylinder. In other words, lap is the condition permitting of expansive working. Lead is given by setting the eccentric forward by a small angle (called the angular advance), in excess of the angle of 90°, which, in its normal position, the eccentric makes with the crank. This causes the valve to be already opened by a certain amount of lead when the piston stroke begins, so that free entry is given to the steam, and the momentum of the piston is checked by an elastic cushion. Lead also gives free clearance to the exhaust by causing that port also to be opened before the end of the stroke.

123.—In what way could the precise position of the North Pole be determined by an arctic explorer who should reach it ?

The North Pole is that point at which the Pole Star appears to travel in a perfectly circular path. Indeed, all the fixed stars will appear from this point to circulate round the horizon in planes parallel to it. Therefore the distance of any point from the Pole can be deduced from observations of the altitude of any fixed star continued during 12 hours, or even less. The magnetic is distinct from the North Pole, and is discoverable by means of the dipping needle.

124.—How deep would it be possible to descend into the earth by mining ?

Concentrated oxygen is a poison. At a depth of 15 miles air would be fatally poisonous, owing to the concentration by compression of the oxygen it contains. By substituting for air a weaker mixture of oxygen with nitrogen (such as is obtained as a waste product in the Brin process), it would be possible for human beings to exist under this "head" of atmospheric pressure. But it is probable that at a depth of about 6 miles, the temperature of the earth would reach nearly 1,000° F. ; and without enormously expensive cooling appliances, it would be impossible for men to live, or for steel tools to be employed, under such a temperature.

125.—How much is a rifle bullet diverged owing to the rotation of the earth ?

This depends upon the direction in which the bullet is fired, and the speed with which it moves. The equatorial velocity of the earth is about 1,520 feet per second ; and the centrifugal acceleration due to this velocity is ·1116 of a foot per second. To this extent, the downward acceleration of gravity is overcome, and it may be said, therefore, that any projectile thrown northwards or southwards is diverged upwards by ·1116 of a foot per second, owing to the rotation of the earth. But if the rifle bullet be projected in the opposite direction to that of the rotation of the earth, and with equal velocity, it follows naturally that its path will be unaffected by that rotation. If the bullet travels to the east—that is to say, with the earth—centrifugal acceleration will be increased. Thus, since the acceleration is proportional to the square of the velocity, we have $(1520 \sqrt{2} - 1{,}520)$ or 630 feet per second as the rate at which a bullet must travel eastwards in order that the upward divergence due to centrifugal force may be doubled. The earth's motion causes a shot fired vertically to fall towards the west, to an extent depending on the height attained.

126.—What is the greatest portion of the earth's surface that can be seen at one time ?

The greatest extent of the earth's surface that has yet been brought within range of human vision is that which, but for clouds, would have been seen by Messrs. Glaisher and Coxwell, on their balloon ascent to the height of 7 miles. To estimate the proportion of the area visible to that of the whole of the earth's surface, we may employ the fact that "the convex surface of a spherical segment is to the whole surface to which it belongs as the thickness of the segment is to the diameter of the sphere." Here the thickness of the segment is approximately equal to the perpendicular elevation of the point of sight above the surface of the earth. Therefore 7 : 8,000 :: 1 : 1,140 and $\frac{1}{1140}$ is the proportion required. From Ætna or from the Peak of Teneriffe only about $\frac{1}{4000}$ of the surface of the earth is visible.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest ; and those selected will be published in the issue after next.

133.—What is a chemical element ?
134.—How is light propagated through space ?
135.—What are the distinctive features of the four known states of matter ?
136.—What is the distinction between a gas and a vapour ?
137.—How should fuel be burned to avoid smoke ?
138.—What is electro-plating ?

ALL chalk is composed of fossils. If you take the tiniest bit and place it under a powerful microscope you will see an infinite number of extremely diminutive shells, and no spectacle on a larger scale is more beautiful than the varied forms of these diminutive homes of animal life which are disclosed by powerful glasses.

MURDER AND THE MICROSCOPE.

One of the greatest aids in the detection of murder crimes is furnished by the microscope in the hands of scientific men. In distinguishing human blood on a knife or razor from rust or from that of another animal, in discovering a particle of poisonous matter invisible to the naked eye, and in various other ways the microscope has rendered invaluable assistance to justice. It has been the means of acquitting many an innocent man whom the chain of circumstantial evidence was drawing toward the gallows, and of delivering many a murderer into the hands of the executioner.

In 1885 a murder of an unusually brutal character was committed. The murdered man, the paymaster of a colliery, had been waylaid in a lonely spot, his throat cut from ear to ear, and his body flung under a hedge. Circumstantial evidence of a very incriminating nature was brought against the prisoner. He had been seen near the spot of the murder about the time the deed was done, and had attempted to disguise himself by cutting off his whiskers; but jurors are very reluctant to convict on circumstantial evidence alone, and the circumstances in this case, though very incriminating, were not thought sufficiently conclusive.

The aid of the detective microscope was invoked. A learned microscopist, on examining the prisoner's trousers, found several spots of human blood, the largest "being not so large as a swan shot." Around these spots were traces of soap, evident signs of the spots having been attempted to be washed out, while over one or two ink had been spread. The ivory handle of a razor found in the prisoner's possession was also smeared with human blood.

A very severe cross-examination left the witness's evidence unshaken. He showed that the corpuscles or globules of human blood can be easily distinguished by an expert from those of any other animal, those found in the human blood being each about 1-3200 of an inch in diameter, those of a sheep being about 1-7000 of an inch; of a dog. 1-3542, etc. A verdict of guilty was found and the man executed.

Another proof of the wonderful detective powers of the microscope was given in another recent case of murder, the victim being an old woman living alone and having a considerable amount of money in her bed-chamber. The back of her head was beaten in, no doubt by means of a large hammer, and the head nearly severed from the body.

The footprints around the house coincided with the imprints of the prisoner's boots: the hammer found besides the murdered woman's bed was declared by a neighbour to have been seen in his possession; a little girl had seen him come from the house on the morning of the murder, and—most conclusive proof of all—in a brook a mile or more from the old woman's house was found a pocket handkerchief, and tightly rolled in it a razor covered with blood, which, it was proved, belonged to the prisoner.

The defence argued: Assuming the razor and handkerchief belonged to the prisoner, and that the blood upon them was human, they may have had nothing to do with this murder, having been found a considerable distance from the murdered woman's house. The microscope answered the question in the most conclusive manner. Upon the blade of the razor, besides the blood marks, were found a few fibres of flax and cotton. On inspecting the murdered body it was found that the razor had partially severed one of the strings of the woman's nightcap, which string was composed of a mixture of cotton and flax.

Another remarkable illustration may be given of the important part played by the microscope in securing the conviction of the murderess. Not many years ago a female child about 9 years of age was found murdered by a deep gash in the throat. Suspicion fell upon the mother, who had been seen by several persons leading the child towards the place where the crime had been committed.

Upon the woman being searched a long and sharp knife was found, which on close examination revealed a bit of fur or hair on the handle. When asked to explain how the fur came there the prisoner brazenly replied: "Yes, I dare say there is, and very likely some stains of blood, for as I came home I found a rabbit fast in a snare and cut his throat with the knife."

The truth-telling microscope cast a different light on the subject. The microscopist, on separating the handle from the blade, found between the two a quantity of human blood, and asserted that the fur was that of a squirrel. The strange fact was revealed that around the child's neck, when the murder was being done, was a tippet over which the murderer's knife must have passed, and which was made of squirrel's fur.

The innocent, however, have also reason to bless the microscope. A few years ago a man was on the point of being sentenced to death, the principal evidence against him being that he was seen near the scene of the murder, and had in his possession a knife "covered with blood." The microscope discovered the so-called blood to be simply lime juice.

Instances of the condemned who have survived the hangman's rope are by no means rare. Not many years ago a man was hanged in this country three separate times, and, either through defects in the scaffold machinery or the hangman's bungling, escaped death after all. People pretended to see in this an interposition of Providence to save a man's life. And, for all that is known to the contrary, it did so interfere, for a woman has since confessed on her death-bed to having committed the crime, and the unfortunate man has consequently been released from jail and presented by the Government with £5,000 and a farm in South Africa, the only condition of his release, we are told, being that he changed his name and never disclosed his identity.

FIRE PREVENTION.

In a recent lecture on fire prevention, Professor Goodman stated that, generally speaking, wooden joists are better for building than steel or iron joists. The two latter materials, he explained, lose their strength at a not very high temperature, whereas wood would sustain a heavy strain for a much longer period when exposed to great heat. Besides, when wood has once been charred it does not burn so readily again. Iron and steel soon expand under the influence of heat. Brick and stone are objectionable; the former becomes fused under great heat, and the latter is liable to crack or fly when suddenly cooled after heating. The drawback to tiles is that when the fire plays upon the joists of floors fitted with them the joists expand and allow the fire to play upon the joists through the tiles. Portland cement is objectionable, as it flakes off when heated, but if wire-netting or bars are imbedded in concrete this defect is remedied. A joist padded with silicate of cotton and incased in salamander plaster (a mixture of silicate cotton and plaster of paris), the professor holds, is a splendid fire-proofing material. Such a material is not only a non-conductor, but it is elastic and would yield with the joist. In an experiment undertaken by Professor Goodman it was found that a joist of this kind withstood very fierce heat for eight to nine hours without sustaining any serious damage.

THE PERSISTENCY OF FAMILY TRAITS.

Not long ago we met a young friend, a bright, charming fellow, who said he was a student of ancestry. Having a weakness in that direction ourselves, we soon became engaged in conversation upon subjects of mutual interest, until we remarked upon the extraordinary persistency of peculiar traits in members of the same family for long periods of time. To our astonishment he immediately informed us that the notion that there is such a thing as "family traits" had been consigned by all the leading genealogists to the realm of myths, and that there is positively no such thing to be met with in human experience. He proceeded to state that old people with active imaginations and defective sight and hearing thought they saw in their descendants the peculiar traits that in youth they had noted in their ancestors. Take from this, he says, the element of imagination, and there remains nothing but the recurrence of the traits of character common to humanity, and that once in a brief interval of time are emphasised in individuals.

He then produced a genealogical chart that showed the ancestors of A. B. through nine generations. A. B. was a direct descendant from L. B., who came from abroad early in the seventeenth century, about 250 years ago. The chart was of the usual semicircular form, with A. B. in the centre, and arranged in concentric semicircles, each semicircle devoted to a generation, with the right quadrant devoted to the ancestry on one side and the left quadrant devoted to those on the other. Of course, if such a chart was complete, as they very seldom are, the second semicircle would contain the names of two parents, the third of four grandparents, the fourth of eight great-grandparents, the fifth of sixteen, the sixth of thirty-two, the seventh of sixty-four, the eight of one hundred and twenty-eight, and the ninth of two hundred and fifty-six. The whole number is five hundred and eleven individual ancestors of both sexes in nine generations. Assuming that no marriages took place between parties of even remote relationship, which is not likely to occur when the nine generations remain locally in the same neighbourhood, the chart would show five hundred and ten ancestors, among which the direct line of B. comprised nine individuals, and occupied a perpendicular line in the centre of the chart.

"Now," says our friend triumphantly, "do you suppose that that line, mixed with nearly five hundred other lines, will preserve anything originally characteristic of it? The idea is preposterous." He continued further, "You will admit that ancestry consists of two elements, heredity and environment. In this case the environment has been the general conditions of farm and village life—practically the same; we can therefore leave that out. Now, heredity remains; do you suppose that anything peculiar remains in A. B. of anyone of the two hundred and fifty ancestors from whom he is descended in the eighth generation from his own?" We answered, most emphatically, "Yes; and they would chiefly lie in the perpendicular line of B." To this declaration he dissented with equal emphasis, and appealed to the chart to prove it. We admitted that, as a geometrical demonstration, the chart was unanswerable, and urged without avail the fallacy of submitting a problem in biology and psychology to mathematical proof. The chart was, he assured us, the genealogist's compass and pole-star, from which there was no appeal.

Further conversation led to numerous citations of examples from our own knowledge and experience, which has been widely extended for many years. These examples, he assured us, were all mere coincidences that would cease to be examples beyond the range of the present generation; that, generally speaking, no man's knowledge extended beyond his grandfather, and that so-called family traits were eliminated by ignoring the great mass of dissimilars, and exaggerating the importance of the few similars. Finally, he challenged us to show that our examples proved anything beyond the observation of a few coincidences.

The problem briefly stated is this: Do persons bearing the same surname and remotely of the same family exhibit traits of character that are common, or in any sense to be considered as "family traits"? The facts within our observation and knowledge we believe to be susceptible of explanation upon a purely scientific basis of well-established principles, without any recourse to either imagination or chance coincidence. John Doe settled in one of the colonies about 250 years ago. The name is not uncommon among middle-class English and is very old, one of the name having held a high ecclesiastical position in the thirteenth century, and others appearing among the lesser nobility a few centuries later. John Doe had a numerous family, of which five sons married, and have descendants now living in localities not far apart. There are descendants of these different brothers living as neighbours in several instances who do not know that they share a common ancestry. Now, it is or is not a matter of fact and observation whether these people, bearing a common surname and descended through from five to eight generations from a common ancestor, exhibit certain traits, or rather a combination of certain traits, which may be called in the aggregate a "Doe character." From our knowledge of the family taken as a whole, that is, the descendants of the five brothers taken together, we declare that there is an unmistakable "Doe character."

If you ask us to describe this character we must decline to do so. It is not necessary. Like all human character it is a mixture of good and bad. Moreover it might be recognised, and we might be restrained from exhibiting our thesis with scientific clearness and precision. Again, there are subtle elements of human character that defy adequate expression in words, and yet are quickly recognised. Nevertheless, we will state how it has been proved to us as an individual: In the first place, by our own observation directed for several years by a knowledge of certain principles acquired in breeding animals; again by remarks made to us, neither solicited nor suggested by us, by members of the "Doe family," who had no knowledge of each other's existence, and who were separated by from five to seven generations; again, by similar judgments passed, not upon individual "Does," but upon the "Does" as a whole, by women who had married "Does," having no knowledge of each other's existence, and whose judgments had been passed upon different generations of "Does."

If "family traits" are a delusion to be explained away by the dilution of a geometrical chart amounting to one two hundred and fiftieth in eight generations, why can independent outside observers, the Does themselves and the women who marry Does, recognise a Doe character in the eighth generation? It is simply because heredity does not involve geometrical elements, in reality is only very inadequately represented by geometry.

Of what, then, does heredity consist? Of a vast number of extremely subtle influences determined by laws as yet but dimly comprehended, but few of which have as yet found adequate expression. Among others there are three laws or principles for which we do not know any name, but which, in their effects, are generally recognised among breeders of animals. First among these may be named the influence of race, which among breeders of animals would be equivalent to "a breed" and the varieties within it.

In every family that can be studied in successive generations the action of this principle explains many seemingly inexplicable facts. To go back to the descendants of John Doe, we have asserted without any fear of possible contradiction that there are "family traits" that may be observed among those who are separated from a common ancestor by six or seven generations. In one case among them a most extraordinary personal likeness was preserved through three generations. They were the fifth, sixth, and seventh generations from John Doe; they were the fifth, third, and fourth children of their respective parents. In the eighth generation the type was continued in the first child, but it is much less marked, and in the ninth generation, the son being the second child, with the influence of the mother very strong.

Still, in both the eighth and ninth generations the Doe traits are unmistakably present. In the ninth generation the fourth child is a daughter, and generally admitted to be a Doe in every fibre of her being. Here is another case from the Does. In the sixth, seventh, eighth, and ninth generations a daughter has appeared in the relations of niece, aunt, great-aunt, and great-great-aunt. We have known them all. In the sixth generation she was the second child, in the seventh the sixth child, in the eighth the fifth child, and in the ninth the third child. They were and are all lighter in complexion than the others of their respective families, with a peculiar cast of features, resembling each other more than they resemble their mothers or sisters. They also possessed in common certain temperamental peculiarities, and their voices would instantly remind the hearer of each other.

Now to go back to our friend's chart, where the perpendicular line represents nine successive male Does. If every one of these eight male Does was a first child of each successive marriage, the Doe influence would be at a minimum, and the transmission of the peculiar traits of the Does most feeble and uncertain. If each one of the eight was the youngest child in a family of six, the persistency of Doe traits would become more intense with each successive generation. For some purposes the tradition of the seventh son of the seventh son becomes something more than a mere superstition. If, however, in the third or fourth generation the surname was transmitted by a son whose father was the second husband of a widow who had borne children by a former husband, the family traits of the Does would doubtless be conspicuous by their absence. There have been no such marriages in the line of Does above mentioned for eight generations.

Too little is known concerning this subtle and intricate question to enable one to venture an estimate of the percentage of tendency towards family traits along the line of nine Does, as compared with any other line from any given individual of the two hundred and fifty of the first generation from the ninth; but we think the challenge of our friend has been accepted and met, and sufficient proof has been submitted to show to any candid mind that a vastly greater proportion than one two hundred and fiftieth may be expected to flow along the line represented by the eight individuals who transmit the surname from the first to the ninth generations. Indeed, we think we are treading on solid ground when we assert that in the letters written by the Doe, who was an ecclesiastic of the thirteenth century, and which have come down through six hundred years to the present time, the "Doe traits" are strikingly evident.

We should be gratified to learn if others familiar with other families than the Does are not fully satisfied that "family traits" are very persistent along the line of the surname.

TEA—DIGESTIBLE AND OTHERWISE.

Tea is undoubtedly one of the most desirable aliments known to the domestic economy. Apart from its nutritive and stimulative properties it has also remarkable medicinal virtues, having a powerful effect in the diminution of inflammatory diseases. On analysis tea proves to be even a substitute for animal food. It has also been found by persons of sedentary habits to take the place of exercise; promoting the activity which it is supposed can only be obtained by physical movement. The tea leaf with the addition of oxygen and the elements of water yields taurine, the nitrogenised compound peculiar to bile, without which the system would be one mass of impurities and digestion impossible. Theine is better adapted to supply the bile with this product than all the other nitrogenised vegetable principles. A decoction of tea also contains albumen and caseine, nitrogenous matters of great nourishing power. Many races in Central Asia live almost entirely on tea, and very sturdy they become on this strange diet. While our own soldiers, at the special command of Lord Wolseley, fought throughout the Egyptian War on no other stimulant than cold tea.

Like all blessings, however, that of tea is not unalloyed. It has an active principle, known as tannin. This substance has a powerful influence on the nervous system and the digestion. It has the power of rendering food in the stomach hard and incapable of assimilation. It is the identical matter used in the tanning of leather, and its effect on food is, therefore, not surprising. When its presence is abolished, a cup of tea, as may be gleaned from the facts we have stated, is the most wholesome drink obtainable. Happily this can be done; the skill of the chemist has once more come to the aid of the culinary department, and in the "Universal Digestive Tea," which has been placed on the market by a Manchester firm, we have the long looked-for desideratum—a tea of delicate aroma and flavour, in which tannin is only remarkable for its absence. We recommend it to our readers because, from personal analysis, we find it proves its claim to public favour.

WHY SCIENCE IS BACKWARD.

Those who were present at Princes Hall, recently when that most graceful and forcible of speakers, Dr. Momerie, held forth on the relations of the Church and Science, were interested to hear why the world is about three hundred years behind the times, if the expression may be used. The dignitaries of the Church never appreciated that freedom of thought which made its own inquiries into the laws of nature, and persecution stopped all research in the middle ages. This persecution is, therefore, responsible for the glorious halo that will always belong to the present age for its wonderful advances, which would undoubtedly have been made much earlier in the world's history if man had been freer.

The oppression of Gervaise and Scotus came at a period when there was a sudden growth of the desire for more knowledge. This scientific spirit was rewarded with the advent of the Inquisition in 1229. This institution immediately set to work to damp the ardour of those enterprising spirits who dared to argue that the world was otherwise than flat, or that it had more than three continents. Columbus, after unspeakable difficulties, succeeded in convincing mankind of the inaccuracy of this last contention. But even then it was argued that as the inhabitants of

Europe, Asia, and Africa—that is, all known humanity—were descended from Shem, Ham, and Japhet, the inhabitants of this new world could not be human, and, therefore, must be devils. For this intelligent reason millions of men were massacred.

The geocentric theory of astronomy, which held that the earth was the centre of everything, prevailed until the fifteenth century, when Copernicus arrived on the scene. Had he dared, he would doubtless have corrected the illusive astronomical knowledge then in vogue. But fear of the Inquisition caused him to publish his facts as amusing hypotheses, with many apologies for their ridiculous nature. Copernicus died, and the Inquisition cursed his name and destroyed his works.

To Giordano Bruno, who lived in the sixteenth century, belongs the honour of having forestalled Darwin's theory of the evolution of the species. He founded a still better theory of astronomy, more in keeping with modern knowledge on the subject. He dared to advocate the plurality of inhabited worlds, but as this was proved impossible, since such people could not be descended from Adam, Bruno was burnt to death.

Galileo then dealt the death blow to orthodox astronomy, by inventing the telescope. He was likewise persecuted to the very grave. But so great were the glorious truths enunciated by these martyrs to science, that they were ultimately bound to obtain credit. Not, however, without keeping the world waiting, with the result, as Dr. Momerie told his hearers, that we are several hundred years behind the times.

WHEN THE SUN MUST DIE.

To humanity a few millions of years hence the lasting power of the sun will be a most momentous topic; to us it signifies little since it is so remote. The extinction of the sun means the extinction of man, for the dependence of human life on the sun is absolute. Even when the sun is withdrawn during the winter season to only a slight degree from the extremities of the earth, it is difficult to sustain life on this planet. What must it be for the whole planet if there should be any considerable diminution of its radiating energy? One of our foremost astronomers, Sir Robert Ball, in the course of a most interesting article that has appeared in the *Fortnightly Review*, places the day when the world will come to an end, as we know it, about four or five million years distant, he gives us every reason to believe that this will be the final winding up of the existence of the human race. He has with considerable labour collected together what may be said on the subject of the duration of life on the globe. It is a noteworthy fact to him that the possibility of the continued existence of the human race depends fundamentally upon the question of heat. If heat, or what is equivalent to heat, does not last, then man cannot last either. There is no shirking this plain truism.

It is obvious, Sir Robert Ball points out, that the available heat generally comes from the sun. So far as the coal goes, we have already observed that, as it is limited in quantity, it can offer no perennial supply. Doubtless there is in the earth some quantity of other materials capable of oxidation, or of undergoing other chemical change, in the course of which, and as an incident of such change, heat is evolved. The amount of heat that can possibly arise from such sources is strictly limited. There is in the entire earth just a certain number of units of heat possible from such combinations but after the combination has been effected there cannot be any more heat from this source.

The internal heat of the earth due to the incandescent state of its interior is the next point to which Sir Robert Ball attracts attention. Here, there is no doubt a large store of energy, but still, he opines, it is of limited quantity, and it is also on the wane. This heat is occasionally copiously liberated by volcanoes, but ordinarily the transit of heat from the interior to the surface and its discharge from thence by radiation is a slow process. It is, however, sufficient for our present purpose to observe that, slow though the escape may be, it is incessantly going on. There is only a definite number of units of heat contained in the interior of the earth at this moment, and as they are gradually diminishing, and as there is no source from whence the loss can be replenished, there is here no supply of warmth that can be relied on permanently.

But we have grounds for knowing as a certainty that the sun cannot escape from the destiny that sooner or later overtakes the spendthrift. In his interesting studies of this subject Prof. Langley gives a striking illustration of the rate at which the solar heat is being squandered at this moment. He remarks that the great coal fields of Pennsylvania contain enough of the precious mineral to supply the wants of the United States for a thousand years. If all that tremendous accumulation of fuel were to be extracted and burned in one vast conflagration, the total quantity of heat that would be produced would no doubt be stupendous, and yet all the heat developed by that terrific coal fire would not be equal to that which the sun pours forth in the thousandth part of each single second.

It was long a mystery how the sun was able to retain its heat so as continually to supply its prodigious rate of expenditure. The suppositions that would most naturally occur were shown to be utterly insufficient. We know that a great iron casting often takes many hours to grow cold after it has been drawn from the mould. If the casting be a sufficiently large one, the cooling will proceed so slowly that it will not get cold for days, because the tardiness of cooling increases with the dimensions of the body. It was not, perhaps, unnatural to suppose that as the sun was so vast the process of cooling would proceed with such extreme slowness that, notwithstanding the quantity of heat poured out every second, the annual amount of loss would be so small relatively to the whole store that the effect of that loss would be imperceptible in such periods as those over which our knowledge extends. This supposition, however plausible, is speedily demolished when brought to the test by which all such questions must be decided—the test of actual calculation.

We can determine with all needful accuracy the store of heat that the sun would contain if regarded merely as a white hot solid globe. When we apply the known annual loss, we see at once that if the sun had merely the simple constitution here supposed, the annual expenditure would bear such a considerable proportion to the total supply that the effect of the loss would become speedily apparent. It is certain that the sun must under such circumstances fall some degrees in temperature each year. In a couple of thousand years the change in temperature would be sufficiently great to affect in the profoundest manner the supply of sunbeams. As, however, we know that for a couple of thousand years, or indeed for periods much longer still, there has been no perceptible decrease in the volume of solar radiations, we conclude that the great luminary cannot be regarded merely as a glowing solid globe dispensing its heat by radiation.

There is another supposition as to the continuance of sun heat which must be mentioned, only, however, to be dismissed as quite incapable of offering any solution to the

problem. As we generate heat here so largely by the combination of fuel, it has been sometimes thought that a similar process may be in progress on the sun. It has been supposed that elements capable and desirous of chemical union may exist in the sun in such profusion that by their entering into association a quantity of heat is liberated sufficient to account for the continuous dispersal by radiation. Here, again, the test must be applied which is decisive of such pretensions. It may certainly be the case that chemical actions of one kind or another are going on in the sun, and among them are doubtless some of such a character that they evolve heat. But we happen to know exactly how much heat can be involved by the action of specified quantities of elementary bodies by whose union heat is generated.

It appears clear from the figures that chemical action is a wholly inadequate method of accounting for solar radiation. To take one instance, we may mention that if the sun had been a globe of white hot carbon, and if there had been a sufficient supply of oxygen to effect its combustion, the total heat generated by the entire mass would not supply the solar radiation for the period that has elapsed since the building of the Pyramids. It is, therefore, clear that the supposition that the sun is a burning globe, like the supposition of the sun as a cooling solid globe, is quite inadequate to explain the marvellous persistence with which, for countless ages, the orb of day has distributed its beams.

There is another supposition which, though not itself providing the explanation that we are searching for, still points so far in that direction that Sir Robert Ball has kept it till the last. It has been somtimes suggested that the dashing of meteoric matter into the sun from outside may afford the requisite supply of energy. It can, however, be shown that there are not enough meteors in existence to supply a sufficient quantity of heat to the sun to compensate the loss by radiation. The indraught of meteoric matter may indeed tend in some small degree to retard the ultimate cooling of the great luminary, but its effect is so small that we can quite afford to overlook it from the point of view that we are taking in this paper.

It is to Helmholtz that we are indebted for the true solution of the long vexed problem. He has demonstrated, in the clearest manner, where the source of the sun's heat lies. It depends upon a cause that, at the first glance, would seem an insignificant one, but which the arithmetical test, that is so essential, at once raises to a position of the greatest importance. It is sufficiently obvious that the sun is in no sense to be regarded as a solid body. It seems very unlikely that there can be throughout its entire extent any portion which possesses the properties of a solid ; certainly those exterior parts of the sun which are all that are accessible to our observation are anything but solid ; they are vast volumes of luminous material floating in gases of a much less luminous nature. The openings between the clouds form the spots, while the mighty prejections which leap from the sun's surface testify in the most emphatic manner to the gaseous or vaporous character of the outer parts of the great luminary.

(To be concluded next week.)

"SCIENCE SIFTINGS" FREE OF CHARGE.

We want every intelligent individual to know of the existence of "Science Siftings." Our readers can help us in this way by introducing the paper to their friends, or by sending us the addresses of those they know, to whom we shall be happy to mail specimen copies free of charge. Furthermore, we will send

"SCIENCE SIFTINGS" FREE FOR A YEAR

to anyone who will send us three annual subscriptions of 6s. 6d. each, for themselves or friends.

WHAT ARE DIATOMS?

Since the microscope has become so familiar in our homes and ordinary places of resort, many terms are frequently heard which have an unfamiliar sound. For example, a lady asked the other day, with a laugh over the open confession of ignorance : " What are diatoms ? I hear the word used very frequently, and with such an air of acquaintanceship and familiarity, that one must suppose they are the most common, every-day affairs, and yet I must confess I have never seen one and don't know really what they are."

Thinking possibly there might be others interested in a brief description of this curious plant, the following story is told of a visit paid this summer to a gentleman said to know *all* about diatoms. The plants in question are so small as to be seen only with the aid of the microscope ; those of ordinary size, when magnified about three hundred and fifty diameters, appear about a quarter of an inch long. Others are much larger. They are curious little plants with a silica shell, which, in certain places, is provided with little apertures through which living parts of the plant protrude. In this way they are enabled to move about freely in the water by which they are generally surrounded, for, though they are not all strictly water plants, they all need considerable water to enable them to thrive, and so are always found in wet places.

Owing to their freedom of motion they were at one time supposed to be animals. Now it is known that they are plants, as they can perform all the functions of plants, and no animal, with all his superiority, high nature, etc., is able to do this. They are found everywhere in all inhabited countries, and in fact all over the seas, so it may be readily granted that a plant so common and widespread as this should be quite familiar to every one.

Again, not only are the living plants so widespread and common, but the shells of the dead ones remain intact for many years ; and in certain localities these tiny shells are so numerous as to form a large portion of the soil. It is often said that Berlin rests on a foundation of diatom shells. The little plant dies and decays, leaving the shell, which retains its shape for many years. These cells are most beautifully marked with very delicate tracery. No tools can be made to perform such work as this. Some shells with the most regular forms of markings are used for testing lenses, such as *Pleurosigma*.

Now, though it is so easy to obtain large numbers of these plants—only a spoonful of mud from the bank of a stream or edge of a pool, a bit of sea-weed thrown up on the shore will contain thousands of them and a great many different forms—though it is quite easy to find them almost everywhere, it is still very difficult to make out their manner of existence. For example, how they perform the feat of locomotion is not well understood. There are two ways of explaining this : one is, that the diatom moves from place to place, owing to the osmotic changes constantly taking place inside the shell ; the other and, perhaps, better authenticated opinion is connected with the peculiarity already referred to —that is, the presence of little apertures in the wall through which portions of the protoplasmic contents protrude. Those who believe in the osmotic theory claim that no such apertures exist, and consequently no protoplasm finds its way to the outside of the shell. In connection with this point comes the story of the visit.

While working in the Botanical Laboratory at Berlin this past summer, the writer was invited to visit a gentleman having the reputation of knowing more about diatoms than any other person now living. It is rather a strange fact

that this gentleman is not a learned professor who has spent a long time over scientific problems, but a retired bookseller who owns a beautiful villa in the suburbs of Berlin, and has for many years been gathering information of various kinds about this wonderful little plant. He has nearly all the literature treating this subject, several large volumes of which are now out of print, and for which he told me he had been obliged to pay exorbitant prices.

Before proceeding to the inspection of the laboratories, specimens, models, etc., coffee and cakes were served in the garden, a distinctively German hospitality which no scientific interests are allowed to interfere with. We then began in the preparing laboratory, a small but very completely fitted room, where the material for investigation is stored, treated, and classified for use. Here are the chemicals used in preparing the plant for examination. Some processes serve to preserve the form and general structure of the living part within the shell, so that this may be studied ; other reagents, on the contrary, destroy the living portion, whereby the shell may be more easily examined. In this laboratory was a microscope of somewhat older style than our recent ones, but a very good, reliable instrument, which he used in the coarser manipulations, but, owing to the presence of chemicals in this room, none of his finer instruments were kept here. He explained his methods of treatment in clearing the soil and dirt from the land specimens, and also showed the little silk nets which he uses when fishing for the water forms. Certain kinds grow only on the surface of the sea : so, to collect these, it is necessary to go out in a small boat and row very slowly, for the cloth of which the net is made must be very fine in order to prevent the escape of the tiny plants through its meshes. Owing to this extreme closeness of the meshes, the water drains through very slowly. The form of the net is quite like those used to catch butterflies, but is held with the handle up and close to the boat. At very short intervals of time it must be taken up and the water poured out ; the inside of the cloth is then carefully rinsed in clear water, which is kept in a jar or bottle for that purpose. The most difficult part of the process is to row slowly and steadily enough to prevent tearing the nets.

These diatoms found on the surface of the water are furnished with long arms or projections, from which protrude hair-like bodies, which apparatus he conjectures is for the following purpose : One means of deciding that this little organism is a plant, is that it performs the function of assimilation, as it is called, by which it gives out oxygen. Now, this gentleman thinks the little hair-like outgrowths are for the purpose of holding the oxygen in their meshes so as to enable the plant to float.

After looking through this room and learning as much as possible about his methods of treatment, we went into another much larger and more elegantly furnished apartment, where all the nice and delicate work of studying forms and making models was done. Here were kept the books, all that have been written on this plant, and they filled a case of considerable size ; also a very complete collection of microscopical apparatus. All that modern artisans can do in the way of fine and delicate instruments may be found here. Nothing less than the best oil-immersion lenses can be used in the study of form necessary to understand the inner structure of these plants. Several models have been made by this gentleman, and it had cost many hours of patient labour to bring out so much as one little turn of the inner canal whose windings hold the living and active part of the plant, and also the explanation of the manner in which it moves. He has studied the mechanism of several forms, and made models of plaster of paris, and others of wire. *Pinnularia major* is the plant from which the most conclusive results were obtained, and he claims to have demonstrated the existence of apertures on the surface of the shell through which the protoplasm may protrude. He does not, however, claim to have actually seen the protoplasm on the outside of the shell, but holds that, according to other known facts, it must be forced out, though in very small quantities. These apertures do not open directly into the interior, but by a series of winding canals whose action prevents the too easy expulsion of the contents. The movement of this protoplasm along the lines between the openings causes the movement of the diatom in a similar manner to the action of the fins of fishes. All this labour, after all, has reference only to a certain class of these plants ; there are many others of such different forms that much study will yet have to be expended on them before their secrets are laid bare.

There are also some curious little forms which grow in clusters on stem-like bodies which are often fastened by their other extremities to some object in the water. There are large collections of these plants in nearly all the large herbaria of Europe, and the manner of preparing them for such collections may almost be said to form a special branch of industry. Experts are able to mount and arrange in order hundreds of these little organisms under a circular cover-glass of about five-eighths of an inch in diameter. The dexterity which these experts acquire in the use of instruments is something almost as marvellous as the organisms themselves. It must be remembered, however, that this mechanical labour has nothing to do with the work of the scientist who studies the plant. It would be impossible for an investigator to give enough time to enable him to acquire this skill. A gentleman in Wedel, Holstein, has acquired a great reputation in this kind of work, and has plates holding from four to sixteen hundred different forms. These cost from four pounds upwards, and he has recently finished a plate on which are mounted four thousand diatoms, with which there is a printed catalogue. This single plate is the result of four years of continued labour, and the price he fixes for it is twenty thousand marks, or about one thousand pounds. According to some of the latest systematic authorities, there are about eight thousand different species.

It may be doubtful whether this story will help to relieve the embarrassment of those who do not exactly understand what a diatom is. It serves to show, however, that very few people do know all about it ; and this, together with the thought that it is considered of sufficient importance to warrant spending years of patient labour over it, will surely prove a consolation to those who have been puzzling over the meaning of the word.

THE INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. 1, price 1s., post free, 1s. 2d.

Or through any Newsagent.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.

Or from Messrs. W. H. Smith & Son, F. & E. Stoneham, and through any Newsagent.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

SOCIAL SCIENCE.

WOMEN AND WOMEN.

The test of every religious, political, or educational system, is the man that it forms, and this is even more true, if possible, of the modern movements in the interest of the feminine sex. Such movements are to be judged, that is to say, by the kind of woman that they produce. If they are providing the world with an improved type of womanhood, then they are to be indorsed and encouraged; if not, then they are to be viewed with distrust and aversion. The question is not one of abstract principles and theories so much as one of practical facts and conditions. All intelligent people favour the largest measure of liberty for both sexes that is consistent with the philosophy of civilisation and the safety of institutions that experience has proved to be of definite value and surpassing importance; but all intelligent people do not favour doctrines and projects that tend to introduce disturbing forces and to unsettle the established relations of society. The reform that merely proposes a change for the sake of change is always of doubtful advantage; unless the change implies a distinct gain in sentiment or character, the existing situation should be maintained. It is better, in short, to be conservative than to adopt schemes of progress which are likely to cost more than they are worth.

There is logic and justice in the contention that discriminations should not be made against a woman simply because she is a woman; but it is another thing to claim that because she is not a man she should have the privilege of trying to be as much like one as possible. The two sexes are respectively distinguished by certain virtues and certain faults that are fundamental. These denoting traits are not the result of accident, education, or environment. They are a part of the fixed order of human nature, and readily suggest a radical difference of duties and responsibilities. When we talk of the equality of the sexes, it will not do to forget that nature has made some distinctions which refute the idea of an intention to place men and women on the same plane in point of service and development; and by parity of reasoning; we are bound to believe that artificial processes which seriously antagonise this arrangement are of questionable wisdom, to say the least. All attempts to harmonise irreconcilable contrarities must necessarily be disappointing, and more or less detrimental. This is one of the familiar lessons of history. No way has ever yet been found to accomplish what is prohibited by natural laws; and it is hardly supposable that such a discovery has been made by the champions of the cause of woman's rights.

"The whole intention of the woman movement," we are told, "is not to declare the rights of women, or to usurp power, or to alienate men, but, on the contrary, to unite men and women on the most enduring basis, and to prove that their interests are indissolubly linked together." This, however, is a begging of the question, and not a candid statement of the truth. The inevitable effect of the movement is to place the two sexes in a hostile attitude toward each other. Every demand of the women for increased powers and privileges is equivalent to a charge of tyranny against the men, since it is by men that these desired powers and privileges are withheld. "Man has splendid qualities, courage, intellect, hardihood," a leader of the fair party graciously allows; but she is not willing to concede that they belong to him by virtue of his sex, as other qualities belong to the women by virtue of her sex. "What woman would not be the nobler and better if the man's qualities were hers?" she exclaims; "and what man would not be grander, happier, more helpful to humanity if the woman's qualities were his?" The proposition, then, is to enlarge the woman's sphere by somehow investing her with faculties that were not given to her when she was created. She is not to be unsexed, it is insisted, but is to be converted into a kind of composite being, with all the virtues of her own sex and the principal ones of the opposite sex—feminine in gentleness and tenderness, and masculine in bravery, wisdom, and pertinacity.

It is obvious that participation in such a movement is calculated to depreciate those virtues which constitute the chief charm and glory of the gentle sex. The women who make a business of struggling for their rights, as they call it, are good and faithful women in their way, but the way is not a pleasant one. They do not command the kind of admiration that is most desirable and most profitable. Their imitation of masculine methods and practices do not make an agreeable public impression. It is more apt to provoke derision than to win praise and honour. At the best, it involves a forfeiture of womanly grace and sweetness that is not compensated by the pleasure of competing with the other sex on the platform and in the newspapers. The mannish woman may be capable and worthy, but she is not a delight to the majority of either sex. Her boasted independence isolates her from her own sex, and does not identify her with the other. She is constantly striving to gain applause for being something that is remarkable only for the fact that it is a perversion of recognised rules and precedents. It is not an improved form of womanhood, but a travesty of the one that has inspired general respect and homage through all the ages. The world is not disposed to accept it as a happy invention, but to regard it as a mistake and a misfortune, because it substitutes arrogance and acridness for meekness and tenderness.

Such a woman does not appeal to that sense of fitness and reasonableness which shapes popular judgment and regulates popular taste. Her devotion to the cause for which she stands may be entirely sincere and unselfish, but that does not alter the fact of her abnormal personality. The traditions that she boldly contravenes survive in spite of her, and she cannot dispel their pervasive and determinant influence. Her eccentricities are often amusing, but never convincing. The interest that she excites is that of a curiosity, and nothing more. If she imagines that people listen to her because they believe in her and would like to have all women emulate her queer example, she is sadly deceived. In her efforts to escape the malady of sameness which is alleged to be the sorest affliction of her sex, she simply makes a grotesque spectacle of herself without in the least persuading mankind to pray that her particular tribe may increase. Her sophistries are not taken seriously by the masses; her style of discussion does not go to show that it would be a good thing to have more women in public life. It is easy to see that her premises are largely erroneous; and so her conclusions are not reliable. She undertakes to solve profound and intricate problems according to the narrow and superficial processes of social chatter and badinage, and succeeds only in illustrating the fatal weakness alike of the cause and of the advocate. Her convictions are a matter of temperament more than of reflection, and she asserts them with an airy self-confidence that is but another name for unthinking vanity.

This is the type of feminine character that the woman movement has developed as a vindication of its spirit and purpose. The degree of its approximation to the best type of masculine character can readily be detected, and the verdict must be that the experiment is a comparative, if not a

complete failure. Society is evidently more of a loser than a gainer by the transformation of womanly women into mannish ones. The sex as a sex has not been adjusted to higher and happier uses through the reform that is thus strikingly signalised. It does not present any new aspects of excellence, or any new suggestions of strength and enterprise.

A sociologist has lately expressed some pertinent and interesting views upon this subject. He grants that the women are not to be blamed for desiring more privileges as compared with those which men enjoy—at least in educational and industrial relations—but he finds cause for regret and apprehension in the estrangement of the sexes that is ensuing by reason of this feminine dissatisfaction with existing conditions. "Everywhere," he says, "you can nowadays see the woman who does not care to be loved and taken care of, and even demands perfect independence in married life. It is plain that the modern woman no longer wishes to be obedient, or even patient. She tries to overcome her physical deficiencies, and wants to become not only man's equal, but his superior." The man cannot be expected to tamely submit to this intimidation, he goes on to say, and the result must be incessant and mischievous conflict where there should be harmony, affection and co-operation. Already, he points out, evil effects are to be observed in the loosening of marital ties, the deterioration of sexual sentiment, and the modification of social customs and ceremonies. As time passes, the situation will certainly grow worse, and the final outcome may be a disastrous convulsion.

In the opinion of this trenchant critic, the estrangement that he speaks of is a disease in the social life of the period, and not an evolution in the progress of modern civilisation. The remedy lies, he contends, in a reconciliation of the sexes. There is no chance for the dream of equality to come true, he declares, because there are such differences in the qualities and abilities of men and women that a miracle would be required to make them alike, and to give each sex the opportunities of the other. "I do not see," he says, "why everything should not be as it was in former times, the man attending to his business and the woman to her domestic duties, with the difference that equity exacts in regard to their social and humane interests." This does not contemplate that the man shall be a tyrant or the woman a slave, but that they shall mutually agree to occupy their respective spheres, according to their respective endowments, and with a just and fair consideration for their relative rights within those spheres. The difficulty at present is that the limitations of sex are practically put aside by those who are seeking increased privileges. There can never be a settlement upon that theory. It would not endure even if it should be made. The woman would still be a woman, with the ineradicable characteristics of her own nature, and the man would still be man, with equally pronounced traits of an independent kind. So it is useless to talk about such a solution of the issue.

It is gratifying to know that we have an assurance of protection against the most serious possibilities of harm from the clashing of the sexes, in the fact that a majority of our women have not as yet allied themselves with the anti-masculine movement. They appear to be contented with their lot, and in no hurry to enter politics. If all the women in the land were voters, they would hardly be able to do more for their sex than has been done and is being done by the men. They would find it necessary to compromise with adverse forces, and to apply the logic of expedience to refractory circumstances, just as it is now the practice. But, as a matter of fact, they are not eager to secure the franchise. Where it has been granted to them for local purposes they treat it with significant indifference, going to the polls only on extraordinary occasions, and rarely taking any part in the selection of candidates. A very little experience suffices to wear out the novelty of the thing, and then they weary of it. In other words, they easily come to the conclusion that it is better to let the men manage political affairs. This is contrary to the philosophy of the woman movement, but it is consistent with sound and wholesome ideas of the dignity, modesty, and sweetness of womanhood. nevertheless, and that is a point of superior importance. The mannish women are in the minority, and likely to remain so. Their peculiarities do not commend themselves to public admiration and confidence. They mean well, it may be conceded, but their style is obnoxious. The world has always preferred womanly women, and there is no reason to believe that it will ever do otherwise.

MAN IN THE ICE AGE.

The glacial period in America afforded Prof. G. F. Wright an opportunity to speculate on the antiquity of man in his fifth lecture before the Lowell Institute. He began with a description of the ice age in America, when 4,000,000 square miles of the northern part of the continent was covered with 3,000,000 cubic miles of ice. In seven or eight places implements made by men have been discovered in the gravel terraces of the glacial epoch, leaving no doubt whatever that man existed on this continent during the great floods that characterised the flow of the ice period.

Taking the evidence afforded by the changes that have been going on in all parts of the world, Prof. Wright said it would seem very easy to conceive that man, originating somewhere in central Asia, migrated on the one hand westward to Europe, and on the other hand eastward and northward to the American Continent, perhaps crossing Behring Straits when it was dry land. For it seems almost impossible to resist the conclusion that the men who lost their implements in the valley of the Somme in France, and the men who lost theirs in Ohio—such implements being almost identical in character—had radiated from some common centre, which had the same state of culture and civilisation. This view is confirmed by a study of the dissemination of the Indian races in America.

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

Fac-similes of Signature.

S. L. Watson.—Perhaps the simplest method is to write the name on a piece of paper, and, while the ink is still wet, sprinkle over it some very finely powdered gum arabic. Then make a rather deep rim round the signature, then pour on some fusible alloy in a liquid state. The impression thus produced may be used to reproduce copies of the signature in printing ink, by means of a hand press. The ink should be applied to this mould in the same way as to a copper-plate engraving.

Reviving Manuscripts.

Enquirer.—To restore faded manuscripts, expose them to the vapour of hydrosulphide of ammonium, or brush them with an aqueous solution of equal parts gallic and tannic acids. This treatment is not applicable, however, to some old and mediæval manuscripts, which are written in inks made of carbon.

Pharaoh's Serpents.

New Subscriber.—A non-poisonous mixture consists of 2 parts bichromate of potash, 3 parts white sugar, and 1 part of nitrate of

potash (saltpetre). The ingredients must be separately dried and finely pulverised, and then cautiously but thoroughly mixed. Press into paper cones of the desired size, and keep from light and moisture. A "serpent" is evolved when one of these cones is ignited at the apex, but it is not equal to that which is produced by the sulphocyanide of mercury.

MAGNETISM IN SHIPS.

A. JONES.—You are right in supposing that ironclad vessels may become magnetic, owing to the hammering of the metal during their construction, and to the strains impressed upon it at sea. The attraction between this magnetised iron and the earth cannot, however, be anything considerable. It has practically no bearing whatever upon the loss of ships at sea.

POLISHING SHELLS.

D. A.—Boil the shells in caustic potash, or in a mixture of soda solution and quicklime. Next rub with a rag dipped in spirits of salt until the dull outer skin is removed. Wash thoroughly in water, and polish with putty powder on a chamois leather. The surface may be finally coated with varnish, if desired. Photographic varnish answers for this purpose very well.

A CHAIN-PUMP MOTOR.

W. WILLIAMS.—The experiment you propose to try—using a chain-pump as a motor to derive energy from falling water—is perfectly practicable. But the motor will not prove economical, on account of loss of power by friction. You would do best, if your water is under pressure, to connect the supply pipe to the pump at an acute angle, that is to say, as near to the perpendicular as possible. In this way you will gain by the momentum as well as by the weight of the water. You might cut through the cylinder of your pump at the point where the water is to be introduced, and dress off the cut edges of the upper section as for a nozzle, and the cut edges of the lower section as for a corresponding socket. Next separate these inclined edges by such a distance as to give you an annular opening of somewhat greater sectional area than the supply pipes. Fit a jacket of corresponding sectional area round the annular sluice, and connect to supply pipes.

MISCELLANEOUS.

H. SUMMONS.—To inhabitants of other planets, this earth would appear somewhat like the planets appear to us; that is, supposing the creatures in question to be possessed of a sense of sight resembling ours. We thank you for your suggestion, but it would be impossible to carry it out under existing advertising contracts.

H. W. B.—A Latin Bible costs 5s., a New Testament, 2s., bound in cloth. Can be had in any binding from Messrs. Cornish, 297, High Holborn.

D. A. P.—We can scarcely tell why dormice should have white tips to their tails. Presumably it is a result of natural selection. Would recommend you to read Darwin's "Origin of Species."

J. HEYWOOD.—We regret we cannot adopt your suggestion at present. We hope later on, however, to publish a series of articles on chemical experiments.

A. C. CALVERT.—Edison's phonograph is not yet on the English market. Its appearance is delayed, we believe, owing to certain litigation between the inventor and the purchasers of the English patent.

J. H. DAY.—You do not state whether you have read Roscoe's "Treatise on Chemistry," or his "Elementary Lessons" only. Without further particulars as to your knowledge of this subject, it is impossible for us to advise you to advantage. The number of books on chemistry is almost unlimited. Ostwald's "Outlines," translated by J. Walker (Macmillan and Co.), is useful supplementarily to the ordinary text-books.

SWEDISH.—"Manual of Swedish Drill," published by Sampson, Low, and Co.

ZUMMERZET.—You may take it for granted whenever the source is not quoted that our staff is responsible for the articles. "Peculiarities—Permissible and Otherwise," was one of these. SCIENCE SIFTINGS should be sufficient authority for quotation. It is more consistent with the ethics of modern journalism for the editor to assume all responsibility, and we prefer to conform with this code. It is surely more modest to remain *perdu* than to blare out the identity of writers in the fashion that prevails in some quarters. When a man has done something great, it is time enough to publish his name; humble seekers after truth should be more modest.

T. H. S.—There is no power of sucking or drawing in a poultice.

YOUNG ORNITHOLOGIST, who inquired some time ago for a periodical dealing with ornithology is notified of *The Ibis*, a quarterly journal devoted to that science, which is published by Messrs. Gurney and Jackson, of 1, Paternoster-row.

H. P. MADSON.—Balloons can be steered to some extent by means of screw propellers or bladed fans, but such apparatus is powerless to make headway against even a moderate gale of wind. Ozone is produced when an electric discharge takes place in air. No appreciable heat is radiated by the stars. Your other questions, which we have had some difficulty in reading, relate to wholly impracticable projects.

VENTRO.—With study and practice it is possible for anyone to acquire some degree of proficiency in ventriloquism. But there can be little doubt that, like singing, it is an art in which great excellence is attainable by comparatively few. You should read a good book on this subject. Several have been published.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers.

PRIZES FOR THE WEEK ENDING JUNE 18th.

The senders of the first twelve letters, opened by us on Monday, June 20th, containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, the 20th instant, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 20th instant. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page ii. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors for the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

*** The Coupon will be found on page ii.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. DALLMEYER "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, Limited, 25, NEWMAN STREET, LONDON, W.

SCIENCE SIFTINGS
A CHATTY JOURNAL.
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6s. 6d. 6 *months*, 3s. 4d., 3 *months*, 1s. 9d

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, JUNE 25, 1892.

SCIENCE NEWS AND NOTES.

"Every being is his own centre to the Universe, and to himself must one of the compasses be fixed to attain to any measurement. Nay, every being is his own mirror to the Universe."

—ELIZABETH BARRETT BROWNING.

Sleeplessness

certainly appears to be more prevalent nowadays than when the different conditions of life permitted our ancestors to take things so much more quietly. It is only reasonable to assume that the sudden jump from the stationary life of the pre-steam age, into the nomadic existence of the steam age, has had a remarkably exciting effect on the brain, and that the outcome is the nervous weakness from which we all appear to suffer more or less. Man requires several generations to acclimatise himself to radical changes; and here are we striving, in a generation or two, to fit ourselves to the most revolutionary of evolutions that humanity has ever experienced. Insomnia is undoubtedly one of the consequences of this endeavour to live at about seventy times the pace of our predecessors.

The Revelation of the Causes of Insomnia

is, however, no simple matter. Thus much, however, we may say, namely, that just as the state of the brain in normal sleep implies a quiescent cerebral circulation somewhat reduced in volume, so in those whose nights are habitually restless we shall commonly find a condition of cerebral vascular tension. This, let it be noted, is not incompatible with general anæmia or with defective brain nutrition. There is, indeed, nothing so conducive to local vascular congestion as the constant exercise of a weakened organ. Mental worry thus acts upon the jaded brain, and we need not wonder, therefore, that it "murders" sleep. The true means of relief is as clear as it is often impossible. In such cases, however, and still more in others where adequate, or even more than adequate, nutrition is maintained, we find a simple and ready antidote in physical exercise. Muscular activity, in fact, may be employed to balance nervous irritation. In it we provide a means of counter-exhaustion. There is a transference of vascular excitement, and of tension, with corresponding relief at the site first affected. A writer in the *Lancet* claims that this process also implies a stimulation of the general metamorphic energy and the removal from the tissues of irritant excretable products.

The Cure for this Dread Disease

is, of course, governed by the origin or cause. Those who suffer from gout or rheumatism, for instance, find a "night-cap" of hot water, or a boiled onion—a stimulant of the kidney—most salutary in effect, since they are calculated to remove the superfluous substances that accompany these complaints. A hop pillow is an excellent soporific, and a cup of hot cocoa, made from freshly-ground nibs, has a like effect. Tea and coffee, owing to their stimulating effect, have a reverse action. Where mental over-activity or irritation has to do with insomnia, the influence of change—that is, of a change in thought—should have a trial. It is no doubt a blind groping after this remedy that induces some to read themselves to sleep. Better in several ways is the practice introduced by the German Kant, who spent some time before he retired for the night in cutting off by an effort of thought each mental occupation of the previous working hours. We might, however, multiply the stock of remedies without meeting all possible needs. The desirable course for any sleepless unfortunate to adopt is obviously not to resort to sedative drugs to allay his distress, but, failing all natural remedies, to seek the advice of his trusted medical attendant and its remedy in the discovery and the removal of its cause.

Food before Sleep

was regarded by the old school of doctors as unwholesome. Indeed, we remember being told in our own childhood that supper had often proved fatal to life, owing to the pressure of the stomach on the spine! These happy-go-lucky physiological rules are rapidly being replaced by common-sense canons. Physicians now recommend to their patients a light meal before retiring. Many persons, though not actually sick, keep below par in strength and general tone, and fasting during the long interval between supper and breakfast, and especially the complete emptiness of the stomach during sleep, adds greatly to the amount of emaciation, sleeplessness, and general weakness we so often meet. Physiology teaches that in the body there is a perpetual disintegration of tissue, sleeping or waking; it is therefore logical to believe that the supply of nourishment should be somewhat continuous, especially in those who are below par, if we would counteract their emaciation and lowered degree of vitality; and as bodily exercise is suspended during sleep, with wear and tear correspondingly diminished, while digestion, assimilation, and nutritive activity continue as usual, the food furnished during this period adds more than is destroyed, and increased weight and improved general vigour is the result. All beings, except man, are governed by natural instinct, and every being with a stomach, except man, eats before sleep; and even the human infant, guided by the same instinct, sucks frequently day and night, and if its stomach is empty for any prolonged period, it cries long and loud.

Digestion Requires no Interval of Rest,

and if the amount of food during the twenty-four hours is, in quantity and quality, not beyond the physiological limit,

it makes no hurtful difference to the stomach how few or how short are the intervals between eating ; but it does make a vast difference in the weak and emaciated one's welfare to have a modicum of food in the stomach during the time of sleep, that, instead of being consumed by bodily action, it may during the interval improve the lowered system. If the emaciated and the sleepless took nightly a light meal of simple, nutritious food before going to bed for a prolonged period, nine in ten of them would be thereby lifted into a better standard of health. A specialist (nose and throat) tells us that he encounters cases that, in addition to local and constitutional treatment, need an increase of nutritious food; and he finds that by directing a bowl of bread and milk, or a mug of beer and a few biscuits, or a saucer of oatmeal and cream before going to bed, for a few months, a surprising increase in weight, strength, and general tone results. On the contrary, persons who are too stout or plethoric should follow an opposite course.

When Man Trys to Regulate Nature's Balance

the result is usually a ghastly failure. The best illustration we can give of this is the introduction of the rabbit into Australia, then to exterminate this plague, his natural enemy, the fox, was imported. Renard now threatens to become an unmitigated nuisance. He attains to a greater size and strength than in England, and gobbles up the lambs and poultry indiscriminately. Still another salutary lesson has been learned by the farmers in the south-eastern counties of Scotland, where at one time were large numbers of owls. The farmers set to work to kill off the owls, forgetting the useful part they play in the destruction of vermin, and now the district has a plague of field mice on its hands, of such proportions that public meetings are being held to devise new plans for fighting the enemy. In some places there is not a trace of vegetation to be found in hundreds of acres, every root and blade of grass having been devoured. The vermin are increasing at a rate which seems to defy all known measures of extermination. The farmers ruefully promise to kill no more owls, but in the meantime they are at their wits' end to know how to grapple with the pest. All of which goes to prove that every creature has its use and is designed as a useful link in the chain of Nature.

The Mongoose

was introduced some time since into Jamaica from India. In a weak moment the inhabitants of that island were beguiled into cultivating the acquaintance of the wiry and vicious mongoose for the purpose of exterminating the rats which devasted the cane fields of the sugar planter. The mongoose simply drove the rats out of the cane plantation into the cocoanut trees, and then applied himself briskly to the extermination of every other living thing that he could overcome. The useful lizards fell an easy prey, as did the snakes, which were not only harmless, but excellent rat-killers; next came the quail and other ground birds, and, after disposing of them, the destroyer took to climbing trees and raided the nests of pigeons, doves, nightingales, and blackbirds. These exercises were varied occasionally by the slaughter of sucking pigs and young lambs, and the commissariat of the island was further seriously interfered with by the decimation of the poultry yards, and irreparable grief was brought to the heart of many a creole by the destruction of the black crab, most delicious of all crustaceans, and always spoken of with pride as one of the delicacies of the island. One of the results of this wholesale havoc is that Jamaica is now bewailing the existence of a plague of biting insects that make life a burden to man and a struggle to horses and cattle, and is praying without hope of delivery from the curse of its own weaving.

A Man who Spells with his Muscles

is a curiosity indeed, but such is the physiological abnormality that we are invited to credit by a correspondent. "You will think it funny," he says, "when I tell you that I spell with my muscles and not with my brains. It is a fact, nevertheless, and I am an expert speller, too. I went to a school where it was contended that the idiosyncrasies of the English language were such that no man could hope to master the art of spelling, if such you wish to call it. My old teacher used to tell us that, as we needed a knowledge of the correct way of spelling mostly when we were engaged in writing, it was best for us to train the muscles of our right arm and hand to do the spelling. With this object in view he would call off to us as rapidly as possible a list of twenty words at a lesson, which we had previously committed to memory, and which we had to write on a slip of paper with the utmost celerity. The same list was repeated daily for a week, when we would begin a new lesson. By this means we cultivated the muscles to act quickly in response to command of the will, until finally we got so that the task of spelling was performed mechanically, pure and simple. So pronounced were the effects of this curious method upon me that if I now stop a half second to think how to spell a word I will invariably get it wrong. But if I just let my hand guide the pen, without any conscious mental accompaniment, the most difficult word in my vocabulary is spelled out correctly." Our correspondent would appear, however, to totally disregard the phenomenon of unconscious cerebration.

The Physiological Effects of Electric Currents

have been dealt with by the celebrated French electrician, D'Arsonval, who has been making investigations into the physiological effects of continuous and alternating currents. Continuous currents have no action on the nerves. In order to contract a nerve near the diaphragm it is necessary to employ one-ten-thousandth part of a volt. M. D'Arsonval contends that non-excitability depends on the constitution and on the nature of the nerves. The effects of alternative currents are quite different. It is necessary, first of all, to distinguish between currents of low frequency and currents of high frequency. If a current is passed between the two hind paws of a dog, or between one front and one hind paw, respiration is suspended. In the case of an accident by alternating currents, artificial respiration should be performed for some time. A case is on record of a dog which was brought back to life after twenty minutes' cessation of breathing. After respiration is performed, it is possible to pass a current of 1,000 volts and one ampere without killing the animal. But the contractions which follow raise the temperature from 38° to 45° at the end of twenty-five minutes, and the animal then dies from the effect of the heat on the heart. Death can be prevented under these conditions by exposing the body to cold. In electrical executions it has been noticed that the temperature rises above the normal limit. This elevation of temperature is caused, not by the electric energy, but by the contraction of the muscles which are operated upon.

Railway Accidents

do not appear to diminish in number or seriousness, notwithstanding the numerous precautions that have invaded our railway systems of late years. It is fact, however, borne out by statistics, that there is less danger in a fast train than

in a slow train, although many nervous individuals always bar travelling by "express." The longer a train is on the road the greater the chances of accident. At 50 miles an hour a train would be two hours in making 100 miles, whereas a train at half that rate would be out four hours. A large proportion of mankind make it a point to get out of their place or to be where they have no business as much as possible, and they would have many more opportunities to get in the way of trains in four hours than in two. As for the greater liability to breakages of equipment and roads under fast speeds than at moderate rates of speed, this is a matter in which railway officials and their patrons are equally interested.

It is a Popular Belief

among railway officials (and everyone else) that high speeds are more liable to break wheels, axles, rails, and all other parts of rolling stock and track fixtures. This belief arises from the fact that heavy blows will cause a break when light ones would not produce a fracture, and it is but natural to suppose that a weak wheel or axle, or one that had a hidden defect, would be more likely to break at high speed. To a certain extent this is correct, but in the main the idea is erroneous. Many of the shocks and jars that have a tendency to break wheels, rails, and axles are lighter at high speed than at low. Rails are not as liable to break from vertical strain under a locomotive running 66 miles an hour as at 30 miles an hour, on the principle that a skater can pass safely over very thin ice, when if he slackened his speed he would break through. A train running at 25 or 30 miles an hour is far more liable to be derailed by any of the common obstructions than one that is running at 50 or 60 miles an hour. Of course there is a certain class of accidents that would be more destructive at high speed. Collisions in time of dense fogs or from mistakes in orders and misplaced switches would be more to be feared on fast trains. But as these causes are but few as compared to other causes of derailment, it follows that any train, running any number of miles at 40 or 50 miles an hour, will meet with fewer mishaps than a like train running the same number of miles at 20 or 25 miles an hour.

An Interesting Phenomenon

relating to two railways comes to us from France. One is the Sceaux line and the other is the Ceinture, which pass within a comparatively short distance of the Montsouris Observatory, Paris, the former line being about eighty metres distant and the latter sixty. It appears that during the passage of trains on the Ceinture line, which is nearest to the observatory, the bifilar magnet is found to be disturbed and its oscillations are registered photographically—indeed the movements are so regular that the curve clearly indicates the exact time of each train passing the observatory. This phenomenon is due to the fact that, as the line crosses the direction of the magnetic meridian, the wheel tires of the carriages become magnetised by induction, and thus produce, in consequence of the laws of magnetism, a deviation of the bifilar magnet. The trains on the Sceaux line give rise to a phenomenon not less remarkable; that is, whenever the driver blows off the steam the electrometer is partly discharged, the electrical potential of the air falling to about one half of its original value. It appears that these phenomena have been considered of sufficient importance to be brought forward by the director of the Paris Observatory in opposition to the proposed extension of the railway from Sceaux to the Place de Medicis.

The Discovery of the North Magnetic Pole,

which is about 1,200 miles further south than the geographical pole, is the object of a proposed American expedition. It is calculated that the magnetic pole is somewhere in the neighbourhood of King William Land, possibly on water instead of land. English and other European explorers have been in that neighbourhood. One of them got within a few miles of the exact point several years ago, and the magnetic needle pointed almost vertically. Its angle with the horizontal was 89° 59′. It is believed that the magnetic pole, which moves around a little, has a regular period that can be determined. It will be of advantage to navigators and surveyors to be able to allow for the variation at any time. Colonel Gilder, who accompanied Lieutenant Schwatka on his expedition, has offered to take charge of the proposed trip to find the magnetic pole, and make a general survey of the surroundings. It is believed that there will be no difficulty in raising the necessary £5,000. It is hoped that the United States' Coast and Geodetic Survey will put the necessary instruments at the disposal of the expedition.

The Striking of Ships by Lightning

is declared to be less frequent than formerly, and Captain Dinklage, of the German Imperial Meteorological Department, has been examining the official logs kept by yachts and mercantile ships, with a view to ascertain the truth of this belief. After a long course of examination, Captain Dinklage is in the position to confirm this opinion, even in the case of vessels navigating the storm-laden tropics. Captain Dinklage finds that this is entirely due to the fact that so many ships are rigged with wires; these wires act as excellent conductors, thus harmlessly tapping the electric fluid and conveying it to the sea. In no case were the wire rigging communicated directly with the iron ships' sides was there any record of disasters from lightning.

Edison as a Man

proves the saying that "the child is the father of the man." "He never had any boyhood days; his early amusements were steam-engines and mechanical forces." So remarks the father (Samuel Edison) of this remarkable inventor. In appearance his biographer (Mr. J. B. McClure) describes him as "pleasant-looking, of the average size (5 ft. 10 in. high), fair complexion, with dark hair somewhat silvered, and wonderfully piercing grey eyes. The latter are almost veritable electric lights, and when engaged in deep thought their look is intense, indicative of decided penetration and acute analysis. His features are well outlined in the engraving given, and show him to be a man remarkably adapted to his line of labour. He is now forty-three years of age. In his laboratory he is too studious to care much for his dress and general make-up. On such occasions he appears, like other hard-working men, often the worse for wear, with acid-stained garments, dusty eyebrows, discoloured hands, and dishevelled hair. But, at the proper time and place, when a better appearance is requisite, he is always equal to the occasion, being "clean-shaven" and handsomely attired in the most approved style.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000possible buyers.

GLEANINGS OF THE GLOBE.

Twenty words per minute is the average at which long-hand is written.

Wars during the last thirty-three years have cost 2,500,000 men and £600,000,000.

Naturalists say that over 800 species of insects and 183 of plants have been preserved in amber.

It is said that a very satisfactory filament for an incandescent lamp can be made from the root of the rice plant.

A mysterious ringing of electric bells in a house in Switzerland was traced to a spider, whose web had connected two wires.

The buffalo is now practically extinct, and yet in 1865 there were over 9,500,000 on the plains between the Missouri River and the Rocky Mountains.

Asafœtida is not, as many suppose, an animal product. It is prepared from the roots and stems of a plant grown extensively in Persia, Beloochistan, and India. In the last-named country cooks use it in all kinds of pudding.

Dew is caused by the radiation of heat into space during clear nights. This is prevented by clouds, which act as a great blanket, tending to retard radiation. The cold earth surface induces condensation from the moist air in the form of dew, much as an ice pitcher condenses the moisture of the air upon its cold surface.

Measurements of weight by the "stone" arose from the old custom farmers had of weighing wool with a stone. Every farmer kept a large stone at his farm for this purpose. When a dealer came along he balanced a plank on the top of a wall, and put the stone on one end of it, and bags of wool on the other end until the weights were equal.

A correspondent of the *Victoria Naturalist*, Mr. Cornwall, states that his gardener, finding the eggs of his fowls diappearing, kept watch and saw the bower bird fly straight to a hen's nest after the hen had left it, and suck the new-laid egg. One was also seen carrying away a hen's egg in his long claws, but he dropped it before he had gone many yards.

Spectacles were invented just six hundred years ago. The use of glass to aid the sight of defective eyes is, however, much older. Nero looked through a concave glass in watching the gladiatorial games, and many other historical men of his day were dependent on similar devices for lengthening their sight. Till the latter part of the thirteenth century only the single glass was in use.

An electric motor is now employed in the United States Navy to work the Gatling gun. It was constructed by the Crocker-Wheeler Motor Company and is attached to the breech of the gun. Formerly a couple of men were required to serve the gun, one to train the piece and drop the shot, the other to work the firing crank; but now one man is sufficient. By touching a switch he can train and operate the gun at will, so as to fire either a single shot or at the rate of 1,200 a minute.

According to Dr. Glaser, a German philologist, the Phœnician alphabet, from which the Greek and other European ones are derived, originated in Arabia among the ancestors of the Minæans and Sabeans probably 3,000 B.C. Dr. Glaser has obtained inscriptions in phonetic characters from Arabic, which are probably 4,000 years old and more. If the early hieroglyphics of the Egyptians suggested a phonetic alphabet, they do not appear to have developed it.

It is ill with a nation when the cerebrum sucks the cerebellum dry: for it cannot live by intellect alone. The broad foreheads always carry the day at last, but only when they are based on or buttressed with massive hind-heads. It would be easier to make a people great in whom the animal is vigorous than to keep one so after it has begun to spindle into over-intellectuality. The hands that have grasped dominion, and held it, have been large and hard; those from which it has slipped, delicate, and apt for the lyre and the pencil. Moreover, brain is always to be bought, but passion never comes to market.

The reason a person sinks in quicksand is because the latter is composed chiefly of small particles of mica mixed largely with water. The mica is so smooth that the fragments slip upon each other with the greatest facility, so that any heavy body which displaces them will sink, and continue to sink until a solid bottom is reached. When particles of sand are ragged and are angular, any weight pressing on them will crowd them together until they are compacted into a solid mass. A sand composed of mica or soapstone, when mixed with sufficient water, seems incapable of such consolidation.

A writer in the May number of the *Mediterranean Naturalist*, speaking of the colours of the waters of the Mediterranean, says they vary considerably at different seasons of the year and in different localities. During storms and boisterous weather the sea assumes a deep green and sometimes a brownish tint, and undisturbed it is of a bright, deep blue. In the Bosphorus, and among the islands of the Archipelago, the water is of varying tints, in some places being of a liquid blue graduating into a brighter green, and in others assuming a blue so deep in its intensity as to almost approach a purple.

It has been estimated that the Dead Sea loses every day by evaporation no less than 6½ million tons of water—an enormous mass, but one which is easily drawn up by the rays of a fiery sun—the valley wherein the sea, which is of about the size of the Lake of Geneva, is situated, being one of the hottest points upon the globe. The vast basin in which it lies is also remarkable as the deepest depression upon the surface of the earth, being more than 1,300 ft. below the level of the Mediterranean. Rocky walls, rising to 2,600 ft. in height, surround it on all sides. It is nourished only by the River Jordan, whose constant tribute of waters must be absorbed by evaporation only, there being no outlet at any point. As a consequence its waters have been concentrating more and more, and so great has its density become that it has been ascertained by actual experiment that the human body floats easily on the surface without any exertion of hands or feet.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 34.

127.—In what way would the brightness of the sun be affected by the removal of its atmosphere ?

The chromosphere or solar atmosphere varying in depth from 1,300 to 1,900 miles reduces the light emitted by the underlying body of the sun about one half. Owing to the selective absorption of the chromosphere it has been estimated that by its removal the violet rays reaching us would be raised to 3 times, and the red rays to 1½ times their present intensities. The proportion of red to violet in the light now received from the sun is about 8 : 5. Evidently the removal of the chromosphere would alter this to 12 : 15, and sunlight would not only be doubled in intensity, but would become of a pronounced blue colour.

128.—Why is a deep black colour on the sea very often the forerunner of a storm ?

The surface of the sea is often agitated while the air above it is quite calm. Thus large ocean waves are propagated in all directions from any local centre of atmospheric disturbance, and may travel into regions of atmospheric calm. And after a long continued storm an undulating condition of the surface may persist in the locality for some time after the aerial motion that gave rise to it has ceased. But although, owing to the momentum of the water, large waves may sometimes be seen in the calmest weather, this is not the case with ripples of, say half an inch or so in length. These are maintained by capillary forces, and very soon die away on the cessation of the exciting cause—as witness the action of wind gusts on the surface of still water. When wind is actually blowing, even with a velocity of only one mile per hour, the smooth and *reflective* surface of the water is so covered with minute corrugations that sunlight falling on it is scattered, and an appearance of comparative blackness is produced. Tolerably regular reflection and a bright appearance is consistent with the existence of the large waves that are left, as has been explained, after a gale of wind has subsided, but not with the small ripples indicative of the present action of wind, and often, though of course not always, the sign of a coming storm.

129.—How is digestion effected in animals ?

Digestion is a chemical process that can be imitated in the laboratory, by which insoluble food-stuffs are rendered soluble and capable of absorption by the animal tissues. In man and similar animals the first solvent brought to bear upon the masticated food is saliva, the active principle in which, the diastatic ferment rapidly renders cooked starch, etc., soluble, transforming the starchy matter into dextrine, maltose, etc. In the stomach, food is mixed with acid gastric juice, containing pepsine, by which gelatinous matter is converted into ungelatinisable modifications—gelatine-peptones ; and also "rennet ferment," by which the casein of milk is coagulated. Next the food is admixed with alkaline bile and with that most important digestive fluid, the pancreatic juice. Pancreatic juice, by virtue of the trypsin ferment, dissolves proteids, such as egg albumen, casein, etc. It also contains a diastatic ferment that acts like the ferment in saliva, but more energetically. Needless to say, the action of the saliva takes place principally in the mouth, that of the gastric juice in the stomach, and that of the pancreatic juice in the small intestine. Upon the whole, digestion may be described as hydrolytic decomposition, or the association of food-stuffs with the elements of water.

130.—In what physical condition should artists' colours be to give the best effect ?

Practically it is not possible to control the shape of the minute particles of pigment, but their size is a matter of some importance. They must be small enough to avoid the appearance of granulation, and to permit of the finest details being marked—points decided by the conditions under which the picture is meant to be viewed. But it is undesirable that the pigment particles should be smaller than is absolutely necessary. For it is only in exceptional instances that their colour is affected by reflection. The colour is generally due to selective absorption of light that penetrates the anterior and is reflected by the posterior surfaces of the particles. Hence for depth or richness of colour the particles should be as thick as possible, so that with a given number of reflections the absorptive effect may be as great as possible.

131.—What is a diffraction spectrum ?

The diffraction spectrum is a play of colours resulting from interference. Rays of light passing through a slit are bent, and if the transmitted light is received on a flat surface it will be observed that interference takes place throughout the whole of the lighted area. This is necessitated by the fact that, at nearly every point in this area, rays proceeding from opposite sides of the slit travel through slightly different distances. Diffraction spectra can be produced directly on the retina of the eye by the interposition of a feather, a piece of fine cambric or any finely ruled grating, between the eye and a bright source of light. Even the eyelashes, when the eye is nearly closed, give rise to diffraction effects on the retina like any other ruled grating.

132.—What is the most probable cause of gravitation ?

Prof. Lodge considers that longitudinal ether waves may very possibly be the immediate cause of gravitation. It has been shown that any kind of motion, taking place in the ether between gravitating bodies, and of intensity proportional to the weights of the bodies, would account for this mutual attraction.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest ; and those selected will be published in the issue after next.

139.—What is space of four dimensions ?
140.—How should water be purified for drinking purposes ?
141.—How are the metals dissolved in a liquid recognised by chemical analyses ?
142.—How is the value of fuel determined ?
143.—Where does the greatest quantity of rain fall ?
144.—Are chronometers or pendulum timepieces most accurate ?

WHEN THE SUN MUST DIE.

A gaseous globe like the sun, when it parts with its heat, observes laws of a very different type from those which a cooling solid follows. As the heat disappears by radiation, the body contracts; the gaseous object, however, decreases in general much more than a solid body would do for the same loss of heat. This is connected with a striking difference between the manner in which the two bodies change in temperature. The solid, as it loses heat, also loses temperature; the gas, on the other hand, does not necessarily lose temperature, even though it is losing heat. Indeed, it may happen that the very fact that the gaseous globe is losing heat may be the cause of its actually gaining in temperature, and becoming hotter. This seems a paradox at the first glance, but it will be found not to be so when due attention is paid to the different notions that belong to the words heat and temperature. The globe of gas unquestionably radiates heat and loses it, and the globe, in consequence of that loss, shrinks to a smaller size. The heat, or what is equivalent to heat, that is left in the globe is exhibited in a body of reduced dimensions, and in that smaller body the heat shows to such advantage that the globe actually exhibits a temperature hotter than before the loss of heat took place.

In the facts just mentioned we have an explanation of the sustained heat of the sun. Of course, we cannot assume that in our calculations the sun is to be treated as if it were gaseous throughout its entire mass, but it approximates so largely to the gaseous state in the greater part of its bulk that we feel no hesitation in adopting the belief that the true cause has been found. To justify the adequacy of this method of explaining the facts, Sir Robert Ball mentions the following result of a calculation. If the sun were to lose sufficient heat to enable it to shrink in its diameter by one ten-thousandth part of its present amount, the quantity of heat that would be available in consequence of this contraction would suffice to provide the entire radiation for a period of 2,000 years. Such a diminution of the sun's bulk would be altogether too small to be perceptible by the most refined measurements that we can make in the observatory. Hence we are able to understand how the prodigious radiation of the sun during all the centuries of history can be accounted for without any alterations in the dimensions of the great luminary having yet become appreciable.

But there is a boundary to the prospect of the continuance of the sun's radiation. Of course, as the loss of heat goes on the gaseous parts will turn into liquids, and as the process is still further protracted the liquids will transform into solids. Thus we look forward to a time when the radiation of the sun can be no longer conducted in conformity with the laws which dictate the loss of heat from a gaseous body. When this state is reached the sun may, no doubt, be an incandescent solid with a brilliance as great as is compatible with that condition, but the further loss of heat will then involve loss of temperature. At the present time the body may be so far gaseous that the temperature of the sun remains absolutely constant. It may even be the case that the temperature of the sun, notwithstanding the undoubted loss of heat, is absolutely rising.

It is, however, incontrovertible that a certain maximum temperature having been reached (whether we have yet reached it or not we do not know), temperature will then necessarily decline. There is certainly no doubt whatever that the sun, which is now losing heat, even if not actually falling in temperature, must at some time begin to lose its temperature. Then, of course, its capacity for radiating heat will begin to abate. The heat received by the earth from the great centre of our system must, of course, decline There seems no escape from the conclusion that the continuous loss of solar heat must still go on, so that the sun will pass through the various stages of brilliant incandescence, of glowing redness, of dull redness, until it ultimately becomes a dark and non-luminous star. In this final state the sun will literally join the majority. Every analogy would teach us that the dark and non-luminous bodies in the universe are far more numerous than the brilliant suns. We can never see the dark objects; we can discern their presence only indirectly. All the stars that we can see are merely those bodies which at this epoch of their career happen to be so highly heated as to be luminous.

There is thus a distinct limit to man's existence on the earth, dictated by the ultimate exhaustion of the sun. It is, of course, a question of much interest for us to speculate on the probable duration of the sun's beams in sufficient abundance for the continued maintenance of life. Perhaps the most reliable determinations are those which have been made by Prof. Langley. They are based on his own experiments upon the intensity of solar radiation, conducted under circumstances that give them special value. Sir Robert Ball gives a summary of the interesting results at which he has arrived.

The utmost amount of heat that it would ever have been possible for the sun to contain would supply its radiation for 18,000,000 years at the present rate. Of course, this does not assert that the sun, as a radiant body, may not be much older than the period named. We have already seen that the rate at which sunbeams are poured forth has gradually increased as the sun rose in temperature. In the early times the quantity of sunbeams dispensed was much less per annum than at present, and it is, therefore, quite possible that the figures may be so enlarged as to meet the requirements of any reasonable geological demand with regard to past duration of life on the earth.

It seems that the sun has dissipated about four-fifths of the energy with which it may have originally been endowed. At all events, it seems that radiating energy at its present rate, the sun may hold out for 4,000,000 years, or for 5,000,000 years, but not for 10,000,000 years. Here, then, we discern in the remote future a limit to the duration of life on this globe. We have seen that it does not seem possible for any other source of heat to be available for replenishing the waning stores of the luminary. It may be that the heat was originally imparted to the sun as the result of some great collision between two bodies which were both dark before the collision took place, so that, in fact, the two dark masses coalesced into a vast nebula from which the whole of our system has been evolved. Of course, it is always conceivable that the sun may be reinvigorated by a repetition of a similar startling process. It is, however, hardly necessary to observe that so terrific a convulsion would be fatal to life in the solar system. Neither from the heavens above, nor from the earth beneath, does it seem possible to discover any rescue for the human race from the inevitable end. The race is as mortal as the individual, and, so far as we know, its span cannot under any circumstances be run out beyond a number of millions of years which can certainly be told on the fingers of both hands, and probably on the fingers of one.

(Concluded from last week.)

THE INDEX TO VOLUME I.
may be obtained on application to the Publishers, price 2d., post free 2½d.
Covers for binding Vol. 1, price 1s., post free, 1s. 2d.
Or through any Newsagent.

IS MIND MAN'S PROPERTY?

Where has mind come from? Is it the mere result of happy organic compounds and relations? There is evidence, on the contrary, that the world has always been as fully charged with intelligence as now. We must remember that at present the insect world displays as remarkable skill in engineering, and in all arts economic and æsthetic, as we possess ourselves. It is easy to call this instinct, but what is instinct but completeness of wisdom; wisdom not in the process of growth as a rule, but already securely possessed? There it is, all the same. Have the insects, like the bee and ant, passed through an era of inspiration and progress, an era of learning and logic, when they did not know what they now do know, but were finding it out, just as we are feeling our way to certainties? It is difficult to conceive of any farther great accumulation of instinct. The spider seems to be learning nothing more; so with most insects. Bees and ants possibly are able slightly to readjust themselves to environments; but on the whole are growing no wiser.

It certainly looks as though there had been a time on the earth when these small rivals of ours were in another stage, an age of accumulating experience. At any rate then the intelligence and moral altruism was causing complex social organisms to exist, and individual traits of character, like obedience, order, courage, love. We may even go farther back to a time when what are now vegetable instincts, sympathies, antipathies, adaptations to environment, mimicry, etc., were conscious efforts. For it is now understood by all scientists that if we go far enough back in geological eras we find animal and plant life undifferentiated, or one. When was intelligence there? No more absent than now from the globe. Therefore, we must think of the world as an organism, every atom of which is filled with purpose and desire, and that always was intelligent and moral, exactly as our own organisms are permeated with our individual intelligent purpose.

Sir Samuel Baker, in speaking of an elephant he came across in Ceylon, says she was particularly sagacious, and her farming work being completed, she was employed in making a dam across a stream. She was a very large animal, and it was beautiful to witness her wonderful sagacity in carrying and arranging the heavy timber required. "The rough trunks of trees from the lately felled forest were lying within fifty yards of the spot, and the trunks required for the dam were about 15 feet long and 14 to 18 inches in diameter. These she carried in her mouth, shifting her hold along the log, before she raised it, until she had obtained the exact balance; then, steadying it with her trunk, she carried every log to the spot and laid them across the stream in parallel rows. These she herself arranged, under the direction of her driver, with the reason apparently of a human being. The most extraordinary part of her performance was the arranging of two immense logs of the heaviest woods. These were about 18 feet long and 2 feet in diameter, and they were intended to lie on either bank of the stream, parallel to the brook, and close to the edge. These she placed with the greatest care when told to do it, unassisted by any one. She rolled them gently over with her head, then with one foot, and keeping her trunk on the opposite side of the log, she checked its way whenever its own momentum would have carried it into the stream. Although I thought the work admirably done, she did not seem quite satisfied, and presently got into the stream and gave one end of each log an extra push with her head, the two trees now lying exactly parallel, and close to either bank." It seems to be nearly as difficult for us to conceive of a high order of intelligence in huge bulk as in the tiny frame of insects. Indeed we have no definite and fixed idea of why and when high reason should be manifested. We associate reasoning with the brain, and the relative proportion and condition of the brain, which is perhaps correct.

We have seen so many instances of positive deduction in horses that we do not hesitate to credit what Mr. Bayard Taylor, the well-known American traveller, asserts of one that he owned. He says: "In the company of a friend I was driving along a country road in a light open buggy. I paid no attention to my horse, for he could turn back or execute any other manœuvre in harness, as well without as with a driver. Halting at a house where my friend wished to call, I waited for him outside. Presently the horse looked back at me, twisting his body between the shafts in a singular fashion. I perceived that he had a communication to make, and said: 'What is the matter now, Ben?' Thereupon by twisting a little more he managed to hold up his right hind foot, and I saw that the shoe had been lost. 'That's right,' said I, 'you shall have a new one as soon as we get to the village.' He set down his foot, and for a moment seemed satisfied. Then the same turning of the head and twisting of the body were repeated. 'What, Ben? Is anything else the matter?' I asked. He now held up the left hind foot, which was still shod. I was quite at a loss to understand him, and remained silent. He looked back at me, and evidently saw I was puzzled, whereupon he set his foot down, and seemed to think. Almost immediately he lifted it up again and shook it vigorously. The loose shoe rattled. There was a positive process of reasoning." We agree with Mr. Taylor in believing that the only reason we do not see more of the logic of animals is because we are ourselves so illogical as to discredit their capacity.

Taylor says that his first knowledge of the finer qualities of horses was gained when he was a boy of 14. He was walking along a lonely road with a companion, and came upon an old grey horse standing in the middle of the road, over a man who was lying on his back. "We hastened to give assistance, but found that the man, instead of being injured, was simply dead drunk. He had tumbled off, and his whisky bottle lay beside him. The fore feet of the horse were firmly planted on either side of his neck, and the hind feet on either side of his legs. This position seemed dangerous for the man, and I tried to draw the animal away. But he resisted with such determination, snorting and laying back his ears, that we were convinced he was carefully protecting his master against passing vehicles."

Sir Samuel Baker describes with enthusiasm the performances of his pet hound, Bluebeard. An elk had taken to water, and kept it a long way down stream. Bluebeard came in on the trail, and touched water. He first jumped in and swam straight across; here he hunted the bank for several hundred yards down the stream, but did not find the scent. Then he went back and swam over to where he first reached the stream, and then hunted along the bank, but found no trail. This being in vain he took once more to water, and swam first to one side and then to the other, searching first on one bank and then on the other. At last he approached the place where the elk had landed. He had argued the matter out fully as well as a man of good brain power.

A fox has been known to improvise a battering ram in order to steal young pigs. A farmer baited a trap for a fox which stole his poultry. At fourteen successive visits to his trap he found it sprung and a stick of wood in its

jaws, but the bait eaten. He could do nothing but wonder and try again. There were no tracks about but those of a fox. But on the fifteenth night he found the old rogue caught by his nose, and in his mouth the stick of wood. He had been careless while putting the wood in the trap with which to spring it, and was fast. But the rational cunning of foxes is an old story. Many animals that are special objects of "sport," or are always liable to be preyed upon, have developed a wit of self-protection beyond that generally manifested by human beings. The fox is an acute example of what we call cunning.

A scientific contemporary vouches for the story of the elephant's power of using tools. One of its writers says that in Eastern Assam he himself saw a young elephant step up to a bamboo fence and pull out a stake. Placing it under his foot, he broke off a piece with his trunk, but threw it away, and broke off several more, until a piece seemed to suit. Holding that in his trunk, and placing his left fore-leg well forward, he began to use the bamboo to scratch his armpit. To the observer's astonishment, a large elephant leech, 6 inches long, was dislodged, and fell to the ground. This could not have been otherwise gotten rid of by the animal. He adds that he subsequently found that leech-scrapers are used by all elephants daily. On another occasion he saw, at a time of year when flies were tormenting, an elephant break off some young shoots well branched, and trim them well into a wisp or fan, and then use it to brush off the flies. Say what we will, these were both *bonâ fide* implements, each intelligently made and used for a definite purpose. Monkeys are also tool-users, for they select stones to break nuts with; but we have no proof of their ever getting as far as the early anthropoids and chipping flints.

The extraordinary reasoning faculty with which a shepherd dog attends to sheep and cows is applicable in many other directions. A farmer found a coop of chickens had been overturned and the chicks scattered over the premises during a severe storm. As soon as possible the family engaged in catching the terrified creatures. A shepherd dog, noticing the difficulty of catching them, lent his aid, picking up chick after chick carefully and carrying it, without the least injury, to the restored coop. We have played ball frequently with a big-headed and intelligent pug dog. He showed remarkable skill in hunting the ball, and whenever we entered his master's house would run to find a ball and urge us to have a game. But one day the ball was laid away in a drawer that occupied the centre of a writing dusk. The dog wanted that ball badly, and, after waiting for hours for some one to help him, concluded to help himself. He tried pressing his feet against it, and by pulling at the knob, but, of course, failed. Then, after more study, he crawled under, and, standing on his hind legs, he inserted his paws and pushed the drawer open. Instantly he appeared in front, and leaped in and secured his plaything. We have seen several cats that would open doors by pressing down the latches; and we know of a great cat that, if he wishes to get out of the cellar, goes to the wire connected with the front door bell and pulls it. But one may fairly believe almost anything remarkable concerning some breeds of cats and of dogs.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.

Or from Messrs. W. H. Smith & Son, F. & E. Stoneham, and through any Newsagent.

A BABY'S FOOTPRINT.

Bret Harte's miner, who, after his interview with the babe, whose advent had been a matter of such interest to the occupants of Roaring Camp, held up his finger and remarked, "He wrastled with it," is now cited by the learned in science as having expressed a significant biological truth. The singular clinging power of an infant's fingers must have been observed by anyone who has been subjected to that species of violence. The babe can have no use for any such strength, and this excess of power is said by the evolutionists to be a quality which the race acquired when it lived among the branches of trees, and has not yet lost. A few months ago, Dr. Louis Robinson published an account of some experiments which he had made upon this subject. These experiments were made in the cases of more than sixty children, all of whom were under a month old, and at least half of whom had been less than one hour in the world. With two exceptions, all of these babies were able to hold on to a finger or a stick three-quarters of an inch in diameter by their hands, hanging as if from a horizontal bar, and sustaining the whole weight of their bodies for at least ten seconds.

The same writer has now contributed to the *Nineteenth Century* an article on the foot of a baby, with the intention of showing that its characteristics are prehensile. He says that there are two classes of feet, those which are used only for progression and those which have more complex functions. In the first class come all the hoofed animals. The construction of the foot in this class is simple, as its functions are simple. It has to sustain the weight of the animal, and is, therefore, very robust, a characteristic for which man has found an artificial substitute in the boot. Among feet of the second kind would be those of cats, for instance, which have, besides the power of locomotion claws with which to climb. The apes, by reason of the very complex functions and construction of the foot, would have a special claim to be put in this class. Climbing with claws is simply walking, with the added power to drive the claws into the bark. But the feet of a monkey in the branches of a tree running away from a cat or snake, have much more difficult and complicated offices to perform. The foot of a monkey must be prepared to seize at almost any angle a branch of a tree with a firm grasp, or in an instant to clasp a spray of fine twigs and cling to them.

It is said that the wonderful range and versatility which the hand of a great pianist or conjurer shows is the result of the struggle for existence among his arboreal ancestors. Now, although the foot of man is at present used only for locomotion, it has the same complicated system of muscles that the hand has. It has, indeed, the same muscles, there being only one muscle in the hand, a small one, with no attachment to the bone, for which there is not a corresponding muscle in the foot. But how is it that these muscles, which are for the most part useless, remain a part of the human anatomy? The answer of the evolutionist is that any part of the animal economy which has become inbred remains after it has ceased to be useful, unless it should be injurious, and the human foot is said not to be injurious. We venture at this point to suggest that it may be injurious. The delicate and complicated structure of the foot necessitates the artificial hoof, the modern boot, which is the cause of the corn and the bunion. Can it be that the human race is destined to undergo some important modification as the result of tight boots? We have already shown in these columns that such will probably be the case.

But the feet of very young infants have a resemblance to those of monkeys which adult feet have not. In the first place, the toes of babies are more easily moved than those of adults. The great toe is shorter than the second and third, and is separated from the other toes by a wide interval. A very young baby often holds his foot very like a fist, the four outer toes being bent downward and showing a distinct knuckle on the other upper side, and the great toe being bent and turned inward across the sole. When the foot is in this position the great and little toes approach under the others, and Dr. Robinson has seen one baby in whom they very nearly touched. Any slight irritation of the skin of the sole of the foot will cause the infant to close the toes as if to grasp the object which has caused the irritation.

Moreover, a close examination of the sole of an infant's foot shows that it contains lines just like those of the palm of the hand. When the toes are bent downward these become creased, showing the natural folding places of the integument, when the act of grasping takes place. Dr. Robinson has examined these lines on the feet of a very large number of infants, first taking photographs of the feet, and later (which he found much better) impressions of the infants' feet on paper. Some of these impressions are reproduced in the article, and they show very distinct lines which the writer says correspond closely to the lines which in palmistry are the "line of the heart," the "line of head," and the "line of life." These lines disappear almost as soon as the children begin to walk. They can scarcely be seen at 14 months, and are only present in a few cases after the infant has reached 2 years. In adults, no trace is to be seen of them when the foot is at rest, and only the faintest indications when the toes are bent to the utmost. There is no analogous case among the other animals of handlike lines existing on the feet in infancy and disappearing later. The bear has a foot which is very human, singularly like that of a negro, yet the bear cub has no such lines on his foot, the lines rather resembling those of the cat tribe, to which he is related.

But do the lines which Dr. Robinson has found on the feet of new-born infants exist on the feet of monkeys ? The lines on a baby's foot are handlike, and indicate a prehensile utility, and a monkey's feet are, of course, prehensile; but are the lines identical ? Dr. Robinson has met with some difficulty in pursuing his researches regarding monkeys' feet, the monkeys objecting strenuously. Moreover, the lines differ greatly in the different families of monkeys. But it was found that the higher the ape the more do its foot-lines resemble those of a new-born infant, these investigations tending to confirm the evolutionist's theory of the origin and history of man.

DR. HOLMES ON TREES.

I shall speak of trees as we see them, love them, adore them in the fields, when they are alive, holding their green sunshades over our heads ; talking trees, with their hundred thousand whispering tongues, looking down on us with that sweet meekness which belongs to huge, but limited organisms—which one sees in the brown eyes of oxen, but most in the patient posture, the outstretched arms, and the heavy drooping robes, of these vast beings endowed with life, but not with soul—which outgrow us and outlive us, but stand helpless, poor things; while Nature dresses and undresses them, like so many full-sized, but under-witted children.

A LUMP OF SALT AND A GLASS OF WATER.

With ordinary use the powers of eye, ear, smell and touch fail to distinguish between the glass of pure water, and that to which salt has been added. The taste alone gives immediate evidence of the difference. But let us examine more closely, and, first, by chemical tests. Solution of silver nitrate, added to the brine, gives a white, curdy precipitate containing chlorine, a platinum wire would take up enough to impart a yellow colour to the Bunsen flame, indicating sodium. Thus two constituents may be separately recognised in the solution by the appropriate tests, where only common salt was added. So, in general, if we wish to detect a salt in solution, we depend upon properties belonging to the basic radical and those belonging to the acid radical ; the appropriate tests being separately applied. Such properties are called "additive," since they express the sum of the properties of the constituents. The special use of this term may be clearer on reviewing some electrical properties.

Two kinds of solutions are distinguished by means of the electric current. Absolutely pure water seems to be a non-conductor, while the addition of a salt, acid, or base enables the current to flow, the added body being separated into two parts called ions, which appear at the two electrodes. Such bodies are called electrolytes ; and the quantity of electricity passing through the fluid is directly proportional to the quantity of electrolyte decomposed. Many organic bodies are not thus decomposed, their solutions being non-conductors. While the molecule of common salt is believed to contain but two atoms, and sugar contains at least forty-five, yet the former may be separated by the electrical influence in a manner from which the latter is free. The forty-five atoms of the sugar molecule dwell together as a unit, while the two atoms of common salt may part company and enter into new relations, thus presenting a scene of activity and complexity which we should hardly expect from its apparent simplicity.

Let a current pass through a solution of copper sulphate, entering through a copper plate, and passing out at any properly coated form ; the copper is carried through the solution with the current, and is deposited as an electro-plate coating ; while the negative radical slips back to attack the cathode. The quantity of basic and acid radicals thus transferred, under given conditions, depends upon the conductivity of the solution.

If we leave water and brine in the cold both will freeze ; but the brine must be cooled to a lower temperature before freezing begins. The differences between freezing point for solutions and the solvent have been made the subject of many extended researches with special forms of thermometer. Readings are estimated to ·01°. The result has been a flood of light upon the molecular weights of substances in liquid form, together with some remarkable differences between salt and sugar, between brine and syrup, or between the two classes of solutions which these represent.

Take three similar barometers, introduce a drop of water into the Torricellian vacuum of the first, and the mercury falls ; the water is partly changed to vapour, which exerts a certain pressure on the mercury, and this vapour pressure may be measured by the difference in level. Now put a drop of brine into the second barometer, the mercury falls here also, but to a less extent. The vapour pressure of the brine is less than that of pure water. The process of evaporation or condensation in a current of air affords another means of determining the relative vapour pressure of various solutions. If we now boil water and brine in separate vessels, the pressure of vapour equals that of the atmosphere ; but, when this

point is reached, the brine is hotter than the water—the boiling point of the former is higher. Thus we have a third method of comparing vapour pressures. This property of solutions, in its quantitative aspect, rivals the freezing point as an avenue to the secrets belonging to our subject, which are yet only partly disclosed. As solution proceeds the denser brine gradually mixes with the water above, until at last the whole fluid would be practically uniform.

Various salts will diffuse at different rates. A porous membrane will transmit the molecules of water more readily than those of a salt. For certain theoretical investigations we may conceive a "half permeable" wall with openings so small that the water alone can penetrate. As a filter separates a solution from the insoluble residue, so the half-permeable wall is to transmit the solvent, while preventing the passage of the dissolved salt. No material has been found fully possessing this ideal property; but theoretical deductions have already been confirmed by experiments with clay cells, the pores being partly closed with a film of insoluble precipitate. If a solution fills such a cell, while fresh water surrounds it, the contents soon show a considerable pressure, which is measured by a manometer. This phenomenon is called "osmotic pressure," and we may have several conceptions of its cause. Either there is an attraction between the unlike molecules in the brine and the fresh water, so that the latter flock in where the salt is imprisoned (as ducks fly to the decoy) until the internal pressure arrests the flow; or the osmotic pressure may be due to the aggregate force of impact of the many moving molecules; this is the view generally taken. The several properties that have just been considered require numerical expression, but these numbers are wonderfully related to each other and to the doctrine of the conservation of energy.

The three fundamental laws of gaseous matter are found to be true of dissolved matter simply by substituting osmotic pressure for gaseous pressure, while even the anomalies and limitations so long recognised in gases and vapours find their counterparts in solutions. Can we find identity of cause when there is almost identity of result? In a gas matter is in a far more dilute condition than in ordinary solids or liquids; the intermolecular spaces are evidently far greater than the space occupied by the molecules themselves. The same is true in a dilute solution of salt, only here the intermolecular space is largely occupied by the water. In both cases, motion is indicated by the phenomena of diffusion. In both cases, each moving molecule is endowed with kinetic energy, and the sum of the *vis viva* of all the molecules exactly accounts for the laws of pressure.

The formulas used to unfold the kinetic theory of gases may be applied without change to a kinetic theory of solutions. In a jar of hydrogen, the molecule darts hither and thither at the rate of a mile a second, asking for no support save other molecules, from which it rebounds. If hydrogen mixes with the denser vapours of paraffin, it will still exert its own pressure upon the walls of the vessel, as though it were alone. Our salt is less ethereal. The molecules are heavier. They move more sluggishly. Very slowly do they rise, as though climbing with painful effort upon an unsteady ladder of water molecules. Yet, with the aid of the half-permeable wall, their pressure is found to be just what it should be on the kinetic theory, if the salt alone occupied the space in absence of water.

Anomalies and limitations have always been mentioned. There is no "perfect" gas, none that exactly fulfils the fundamental laws, but hydrogen, which most nearly agrees with the "ideal gas" in its properties, is not compressed to one-tenth its volume by ten-fold pressure, but occupies a little more than one-tenth volume. Here, the molecules themselves may be considered as incompressible bodies occupying too great a fraction of the whole space to be left entirely out of account. It is assumed that the total intermolecular space varies inversely as the pressure. In most gases and vapours, however, the deviation is in the opposite direction. As the molecules approach each other their mutual attraction is manifested, for the volume becomes less than required by Boyle's law. The piston of a Corliss engine, which glides so beautifully to and fro, in obedience to valve and governor, is impelled by the bombardment from an army of vapour molecules, each one following its own impulse almost untrammelled in the go-as-you-please contest; yet some mutual attraction is manifest, for the steam exerts a little less pressure upon the piston than would an ideal gas under like conditions. So, osmotic pressure, instead of increasing directly as the concentration, may increase a little less rapidly. There is a well-known body whose vapour density has long been recognised as abnormal.

Ammonium chloride, when converted into vapour, is found to occupy twice the volume predicted by theory—in other words a given volume of the vapour exerts twice the theoretical pressure. On this hypothesis the speed of chemical change should no longer be proportioned to the whole quantity of each active substance present, but rather in proportion to that part which has already suffered loosening of the bonds. The facts of dynamical chemistry afford an independent and valuable confirmation of the new views.

SIFTINGS OF THE STUDY.

First Year of Scientific Knowledge.

By Paul Bert.

(*London: Relfe Brothers.*)

The best testimonial that this little book could receive is the fact that in France 1,000,000 copies have been sold, and the number of the translation—which we owe to the pen of Madame Paul Bert, a Scotch lady—disposed of in this country has already attained to something very handsome. It has been specially modified by Madame Bert to render it suitable to the requirements of English schools, and we cordially compliment the authoress on the way in which she has accomplished her task. The work is excellently classified, and on the whole forms a text book that is neither recondite nor dry, and yet comprehensive withal.

Light and Heat.

By The Rev. F. W. Aveling, M.A., B.Sc.

(*London: Relfe Brothers.*)

For an elementary treatise, which is all the author claims for his book, we consider this volume decidedly well done. Text books on light and heat are not rare, but it is only too usual for them to be produced in a style that places them beyond the comprehension of the average beginner. The elementary student will find that the author has efficiently catered for his requirements, and those about to go up for London Matriculation and the Oxford and Cambridge Local Examinations will find the book well nigh indispensable.

"SCIENCE SIFTINGS" FREE OF CHARGE.

We want every intelligent individual to know of the existence of "Science Siftings." Our readers can help us in this way by introducing the paper to their friends, or by sending us the addresses of those they know, to whom we shall be happy to mail specimen copies free of charge. Furthermore, we will send

"SCIENCE SIFTINGS" FREE FOR A YEAR

to anyone who will send us three annual subscriptions of 6s. 6d. each, for themselves or friends.

INTERESTING FACTS ABOUT BRAINS.

Mrs. Sales, president of the Sydenham Ward of the Women's Liberal Association, has favoured us with some interesting facts about the brains of eminent people, and her own conclusions about their import. Her opinions on this subject, as indeed on most others, are of such general interest that we again publish them for the benefit of our readers.

"At the death of Gambetta his brain was given for examination to Dr. Broeca, the greatest living French physiologist of the day. His report was published in all the French newspapers. It ran: 'Had this brain been presented to me without my knowing to whom it belonged, I should have said, "It is the brain of a woman who has well used all her faculties; it is also below the average weight of the European male brain."'

"Thus was the great French tribune who had opposed woman's suffrage during life, made to illustrate in death the superiority of the female type of brain. But in justice to him, be it said, he did more than any other Frenchman to promote education for girls by public lycées, in order to counteract clericalism.

"It is also known that Byron's brain was below the average in weight, in fact remarkably small. Again, the magpie is known as the most sagacious of birds, and yet among all of them it has the smallest brain, but this brain is the most deeply convoluted. A sheep's brain is a good example of the contrary, presenting a nearly even surface.

"There appear to be four recognised causes of mental and moral superiority in brains. (1) The multiplicity and depth of the convolutions, under which heading that of man is superior to those of animals and children, and those of civilised races to the uncivilised, those of educated to uneducated classes. But when the degree of civilisation and education is equal in the two sexes the female brain is found to be more deeply convoluted than that of males. (2) The size of the brain relatively to the size of the body is a great sign of superiority, and of all beings woman has on the average the largest brain proportionately to her body. (3) The fineness of the texture of the brain, which phrenologists are able to estimate by the degree of fineness of the hair. People of genius have very fine (and generally undulating) hair, while stupid people are remarkable for the coarseness of their hair. In the same way a very high bred-horse is always remarkable for the silky fineness of its coat. (4) The absolute size and weight of the brain as distinguished from its relative size is a general sign of power, but this is by no means always intellectual power, as the extra size and weight in man as compared with woman, and of the elephant relatively to man is caused by the greater development of the animal propensities among the organs of the brain. Also as long as man on the average has a better education than woman and wider fields for the exercise of his faculties, and far more stimulants to ambition, his average larger brain, even if caused by larger intellectual faculties, could be no proof of greater natural and original superiority. As an illustration of the effect of a larger field and greater stimulants for the exercise of the faculties, it may be mentioned that the brain of Disraeli increased one inch round in measure after he entered Parliament."

The ruby and sapphire, says the *Diamond*, by one of the inexplicable chemical enigmas of nature, though differing so greatly in appearance, are chemically the same substance, pure alumina. A ruby may be called a red sapphire, and with equal reason a sapphire a blue ruby.

A SINGULAR WRECK.

Tourists that visit Batavia nowadays are quite out of the fashion if they fail to make the passage through Sunda Strait, and see all that is left of Krakatua and the vestiges of the ruin wrought by the terrible eruption of 1883. If they push up the bay of Lampong, on the Sumatra side of the channel, they are likely to land on the low shores occupied by the village of Telokh-Betong, and hire carts for a short jaunt into the interior; and when they have gone about two miles they will pause to take in the curious scene presented in this picture; for here is seen one of the most interesting results of the great wave of Krakatua.

There was just one man amid all that wild scene of death and devastation who was not overwhelmed in the common ruin. He escaped while 40,000 perished. He was the lighthouse keeper, who lived alone on an isolated rock in the strait. It was broad daylight when Krakatua burst asunder, but in a few moments the heavens were so densely shrouded by dust, mud, and smoke that the darkness of midnight covered all the channel. The guardian of the lighthouse was in the lantern 130 feet above the sea level. Here he remained safe and sound in the midst of the terrible commotion.

He felt the trembling of his lighthouse, but it was so dark that he could not see the threatened danger. He did not know that a tremendous wave had almost overwhelmed the lighthouse, and that its crest had nearly touched the base of the lantern. He did not hear it because he was deafened by the awful detonation of Krakatua.

In a few moments the wave, over a hundred feet in height, had swept along a coast line of 100 miles on both sides of the channel.

Scores of populous villages were buried deep beneath the avalanche of water. Great groves of cocoanut palms were levelled to the ground. Promontories were carried away. New bays were dug out of the yielding littoral. Every work of human hands except that lighthouse was destroyed, and 40,000 persons perished in the deluge that mounted from the sea or beneath the rain of mud that filled the heavens.

One little paddle steamboat was borne on the top of that wave through forests and jungle, over two miles into the country, and was left as the wave receded, standing erect as if in her proper element. It will be remembered that, for weeks before the final cataclysm at Krakatua, the volcano was in a state of eruption. Pleasure parties were made up at Batavia to visit the volcano. Not a few people landed on the island, little dreaming that in the twinkling of an eye two-thirds of it was to be blown into the air as though shot from a gun. They wished to get as near as they thought they might safely venture to the growling, steaming crater. This little steamboat on the day before the explosion carried one of these parties to the island. There were only twenty on board besides the crew. They spent a couple of hours around the island, and then steamed up the deep and narrow bay of Lampong and it is supposed they anchored for the night in front of the big town of Telokh-Betong, which was one of the largest settlements on the south coast of Sumatra.

The ill-fated pleasure party was never heard of again. It is supposed that the boat was turned over and over like an egg shell in the surf. It had every appearance of such rough usuage when it was found some months later. The machinery and furniture were badly broken, and were strewn about in the greatest confusion. But the vessel held together, and was finally set down in good shape, erect on her keel but two miles from the seashore.

Only two bodies were found in the vessel. They were, of course, below deck. As it was morning when she was picked up by the wave, it is supposed that nearly everybody was on shore. Not a vestige remains of the villages that lined the water edge. But the hulk of this little boat still stands, battered and broken, though as erect as when she ploughed the channel, and she is the most curious and interesting relic of the greatest volcanic eruption of modern times.

KITE ELECTRICITY.

Under this heading Dr. Vander Weyde expounds a theory which he adopted some thirty years ago, and has been teaching since, "because it fully explains several facts which formerly have been a stumbling block to the right understanding of many phenomena presented by atmospheric electricity."

Among them is the fact that a kite held by a conductive string (made so by one of the strands being a fine copper or brass wire), when it is made to ascend in a clear, dry, and cloudless atmosphere, with apparently not the least tendency to a thunderstorm in it, will always, without exception, show positive electricity, and more of it in proportion as the kite ascends higher. When a hollow metallic ball is attached to one end of a fine wire, of which the other end is connected with a proper electrometer, and the ball is thrown upward in the free open air, the electrometer will show positive electricity, and may be made to retain it for a short time when the wire is attached in such a way as to become separated from the electrometer when the ball has reached its highest point. A lightning rod arranged at its lower end in such a way that its ground connection can be interrupted will, during or before a thunderstorm, while clouds are floating over it, show alternately positive and negative electricity, but when the sky is clear and dry its electric charge is always positive. Of this Dr. Vander Weyde tells us he had the rare opportunity to satisfy himself by a multitude of experiments on several occasions. De Saussure repeated many more experiments in the Alps, and found always, even in the highest accessible regions, positive electricity when the sky was clear.

The conclusion arrived at, as published in the works of Biot and other eminent investigators, was that the dry, clear atmosphere was always charged with positive electricity, and this in a greater amount in proportion as we ascend higher.

This explanation was sufficient until Biot, during his famous scientific balloon ascension with Gay-Lussac, lowered a metallic globe suspended by a copper wire from the car of his balloon, and found very strong negative electricity in the higher regions. In his description of this experiment he confesses that this is contrary to what De Saussure found in the higher regions of the Alps. He tries some kind of explanation in the second volume of his "Traité de Physique," but as he, like all the electricians of his time, adhered to the theory that the air itself was charged with the electricity which acted upon the electrometer, there was a quandary left to be solved.

The credit of doing this belongs to Peltier, whose theory is that our terrestrial globe is always permanently charged with negative electricity, which according to the law of its distribution, resides principally in its surface, and which, when the air is dry, and therefore a good insulator, will not be communicated outwardly, but will act by induction upon any conducting body insulated above the surface and cause its lower end or under side to become charged with the opposite (positive) electricity, while its upper end or top side will become charged with the similar (negative) electricity, and this by the separation of the two electricities, positive and negative, which are contained in and neutralise one another in all conducting bodies which are not so influenced. Consequently, where a rod or wire extends from the earth's surface upwards, its lower end must become positive and its upper end negative by the inductive capacity of the negative earth, and this explains at once the dilemma why Biot, in his balloon, in testing the upper end of the wire, found negative electricity, while the observers on the earth's surface testing the lower end found positive electricity. The fact is that it was not the electricity absorbed from the air they had to deal with, but with electricity developed in the wire itself, by the inductive influence of the earth's constant negative charge.

Sir William Thomson (in proceedings of Royal Institution, May 18, 1860) declares that he does not agree with Peltier in regarding the earth as a negatively charged conductor. Still he admits at the end of the same explanatory paragraph that "the result we obtain every day of fair weather in ordinary observations on atmospheric electricity is precisely the same as if the earth were electrified negatively and *the air had no electricity in it whatever*."

Recently some other investigators have gone a step further, and striking from the last suggestion of Lord Kelvin have come to the conclusion that actually dry air at the normal pressure of one atmosphere does not and cannot contain an electric charge; also that it cannot conduct nor convey electricity, but only be perforated by the electric spark, as we do in our laboratory experiments, and which nature does in her gigantic laboratory by a flash of lightning.

This theory, striking as it is and contrary to the usually adopted notions, Dr. Vander Weyde continues, is likely to prevail, as it explains fully and satisfactorily two phenomena not otherwise possible of explanation: The cause of a sudden clap of thunder from a cloudless sky and the gradual formation of a highly charged thunder-cloud in very high regions of the atmosphere.

LEADING OPINIONS ON SPACE.

It is impossible to imagine that there should be no space, though one might very well imagine there should be space without objects to fill it. Space is, therefore, regarded as a condition of the possibility of phenomena, not as a determination produced by them; it is a representation *à priori* which necessarily precedes all external phenomena.—"KANT'S CRITIQUE," as translated by Max Müller.

Let a vast sphere be described of such mighty dimensions that it embraces not only all the objects visible to the unaided eye, not only all the objects visible in our most powerful telescopes, but even every object that the most fertile imagination can conceive, what relation must this stupendous sphere bear to the whole of space? The mighty sphere can only be a small part of space. It must bear to the whole of space a ratio less than the water in a single dewdrop bears to the water in the Atlantic Ocean.—PROF. ROBERT S. BALL.

It is not simply the vast in which men have learned to believe, not mere immensity, but the mystery of absolute infinity. On all sides our island home is surrounded by a shoreless sea space.—R. A. PROCTOR.

SOCIAL SCIENCE.

THE PRICE OF EXCELLENCE.

One of the penalties laid upon the brain-worker, and especially the literary brain-worker, is the doom of carrying with him into every work of his experience the shadow of his labouring mood, which projects itself across each phase of life and suggests tantalising possibilities. There is no rest, no absolute escape from the tyranny of habit, even in the most halcyon spaces of offered idleness or recreation. Every wind that blows is a thought ; there is no ripple of stream or sea, no twitter of bird or waft of fragrance that fails to start some available fancy or some new fountain of imaginative energy.

Persistent inquiry has brought us many curious confessions from men and women whose lives have been subject to the god of letters, and it has been a source of comfort, not altogether creditable, perhaps, to know that our own experience has not been harder than the average of our fellow-workers. The thin old saw about misery loving company does not exactly apply to the facts of the case ; for one can never feel any comradeship in the matter of brain-work. Sympathy we have for one another, a helping hand at need, a common desire for the welfare of each individual of our guild ; but, after all, the life of the thinker is a lonely one, becausc it is interior, and all its motors are intrinsic. This is why he can never shake off the sense of his responsibility in the presence of things natural or artificial. He is for ever mindful of his office, the function of which is the interpretation of life and the weighing of the results of life. He is an individual distinctly separated from all the rest of the world by that insulating force which alone gives him the right to recognition as one of the few who can speak with authority.

The doom of unresting thought, coupled with an ever-present sense of the endlessness of duty, is a heavy one when suddenly realised in all its reach of significance. In every effort to turn aside and lose oneself in mere enjoyment, the extrinsic sources of impulse, no matter how powerful, will find themselves checked by the resistance of the inner force which demands responsibility. No loss of time or material, no evasion of vigilance in the matter of observation, no putting off for to-morrow the task of to-day is permitted by the central energy of the creative brain.

Physiologists say that this is an unhealthy condition, wherein the brain has usurped the whole domain of life and crowded out or impoverished the various other vital organs to such an extent that a proper physical economy is impossible. Viewing man as a mere animal, doubtless the physiologists are right ; but we who work with the brain naturally regard the animal man as mere food for the spiritual (or, more correctly, the intellectual) man, and we look upon true health as nothing if it is not the highest state of mental power manifested by creative results. We are too apt to forget that the body must be nurtured in the wisest way in order to furnish the brain with the substance out of which its energy is engendered and maintained. But what is safety, what is wisdom in this connection ? If it is true that great mental labour is sustained at the expense of physical health, is it not equally true that such bodily training, as best develops the physical basis of life, enforces a draft upon the centres of the thought-producing sources ?

Few indeed are the athletes who can show any extraordinary product of mind. Hard muscles they have, hearts and lungs that are capable of immense functional endurance, and stomachs of perfect action ; but how have they come to this condition and how do they maintain it ? The doom of necessity is upon them also. Training, training, no absolute rest, no turning aside from the constant and rigorous performances that keep the physique at its best, or rather at its utmost state of ability to do and to resist ; this is the athlete's duty. Let him relax and call upon his mind for a heavy and prolonged effort : the result will be a softening of the muscles, a decline of the functional readiness of liver and stomach, a weakening of the heart's action, and a general decrease of physical energy.

Here, then, is a choice that every man, every woman must make before setting out upon a career of brain labour. Is there a willingness to forego perfect physical health in order to train the brain up to its highest possibility of effectiveness ? Long life is not for the athlete, nor can the intellectual gymnast count upon it ; but one lives as long as the other, if, indeed, the chances are not positively in favour of the brain-worker. Statistics will show that the Goëthes, the Humbolts, the Tennysons, and the Newtons die no earlier than the men who show themselves masters in physical training ; but statistics will disclose as well that the health of the former has been, physically speaking, negative at best throughout a large part of their lives, while the mental health of the latter has never been sufficient to bring forth any large results.

We may, then, it seems, assume that supremacy, in any field, calls for a great sacrifice. The human economy is not capable of supporting at the same time great mental and great physical activity ; the two developments are not to be perfectly harmonised. It may not be true that the model athlete can take his collar off without unbuttoning it, by simply slipping it over his head, but there is a grain of golden truth in the suggestion, and, although poets and novelists are not all dyspeptics, there are great numbers of them afraid to eat three solid meals in a day.

A sedentary habit is not wholly responsible for the literary man's torpid liver and stomach. The atrabiliousness of Carlyle was probably largely due to the fact that he carried his brain with him to the table and kept up a furious thinking while all his nervous and blood forces were needed at his digestive centre. His head was not willing to forego, even for the hour of eating, the habit which throughout a long life kept it abnormally efficient in its crabbed but stupendous labours.

Doubtless there is a possibility that a brain worker could so train himself that the golden mean might be reached wherein the physical and intellectual man would be developed to something near the ideal correlation; but science has not yet pointed out the process by which this much-desired feat may be achieved, nor is there much probability that it ever will. Nevertheless, we can insist upon logical examination of the subject ; for even the spring poet is a human being entitled to the best remedy called for by his disease. We may execrate his rhymes and deplore his metre ; but we cannot withdraw the hand of enlightened charity.

Physical exercise in the open air is the current prescription for all the ills arising out of sedentary habit ; but what good is this exercise to do him who at the same time continues his exhausting labour of thinking ? But you must leave off thinking when you go out for exercise, persists the physiologist ; as if that were as easy as leaving off one's coat. Will this wise doctor tell us how to close the stops of the brain-organ at our pleasure ? He has prescribed for us, let him show how to take his dose. When he has done this, and we have accustomed ourselves to that vacancy of mind

which alone can insure the last refinement of physical gain from exercise, and the best recreation of the over-worked thinking organ, we shall be able to decide for ourselves whether or not perfect bodily ease is compatible with the highest intellectual fecundity.

TESTING FOR FALSE GEMS.

In most works on gems much stress is laid upon "hardness" as a means of distinguishing real from artificial "stones." Having had occasion during the past two years to examine several emeralds, rubies, etc., as to their genuineness, a correspondent concludes that this property—which is, as everybody knows, of greatest assistance in the determination of uncut minerals—is of very little value in the examination of cut and polished gems, inasmuch as cutting a stone renders its surface much softer—in some cases reducing the hardness by over one-tenth—so that it can be "scratched" by minerals considerably lower in the scale of hardness than itself in its natural condition. On the other hand, many artificial gems will scratch ordinary window-glass quite readily, and have a hardness equal to that of quartz, although it is popularly believed that if a "diamond" scratch glass it must be real.

Polishing the surface of a stone also necessarily affects its specific gravity, especially if the specimen be of small size, as is the case with most gems. Specific gravity as a means of detecting false gems is also rendered practically valueless by reason of the fact that special care is often taken in the manufacture of these articles to make them have specific gravities as nearly like the natural species which they are intended to imitate as possible.

Gems being usually much facetted, an examination of their optical properties becomes difficult, and is of very little use in their practical determination.

Many gems are thought by their owners to be genuine on account of their having been in the possession of themselves or families as heirlooms for many years. Age in this case is no criterion as to value, as it is well known that the ancient Egyptians and Greeks were well versed in the manufacture of artificial stones.

The grand and really only reliable test, it seems, as to the genuineness or otherwise of a gem—in case we do not wish to totally destroy the specimen—is an examination of its fusibility. Artificial diamonds, emeralds, etc., if held in the border of the flame of a spirit lamp or Bunsen burner, soon become rounded on their edges, their fusibilities being generally considerably under three, according to von Kobell's scale of the fusibilities of minerals. The real stones, diamonds, etc., with the exception of the garnet, are practically infusible.

Great care should be taken in the examination of the fusibility of a gem, as, if the latter be genuine, it may, unless heated, gradually and carefully, crack and fly to pieces on exposure to a high temperature. Moreover, some gems will change colour if heated too highly.

THE "GLASS AGE."

So far as research has been able to determine, glass was in use 2,000 years before the birth of Christ, and was even then not by any means in its infancy. In the Slade collection at the British Museum there is the head of a lion moulded in glass, bearing the name of an Egyptian king of the eleventh dynasty. This is the oldest specimen of pure glass bearing anything like a date now known to exist. The invention now known as "bleezing," the mode of varnishing pottery with a thin film of glass, is believed to date back to the first Egyptian dynasty. Proof of this is found in the pottery beads, glass glazed, found in the tombs of the age above referred to.

Amateur Photographers Competition.

The awards in this competition will be duly made in our next issue.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers.

PRIZES FOR THE WEEK ENDING JUNE 25th.

The senders of the first twelve letters, opened by us on Monday, June 27th, containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, the 27th instant, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 27th instant. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page ii. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors for the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

*** The Coupon will be found on page ii.

N.B.—The Competition for the week ending June 11th resulted in ninety-seven correct solutions being sent in for the 2s. 6d. competition. Prizes of 2s. 6d. each have accordingly been sent to the ten competitors whose letters were first opened. Eleven competitors only entered for the 10s. prizes, the number of correct solutions sent in varying from four to forty-three. The two largest numbers were forty-three and thirty-seven. Others sent in correct solutions to the number of thirty, twenty-nine, twenty-seven; two competitors sent in twenty-four, and one eighteen; the remaining three sent in twelve, eight, and four correct solutions respectively.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*, 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, JULY 2, 1892.

SCIENCE NEWS AND NOTES.

"Pass, then, through the little space of time conformable to Nature, and end the journey in content, just as an olive falls off when it is ripe, blessing Nature, that produced it, and thanking the tree on which it grew."
—MARCUS AURELIUS.

A Volume of "Science Siftings"

will be presented by the Editor to the head master of any school within the Queen's dominions. These gifts are intended as prizes for the middle and upper forms; and to those schools containing more than fifty pupils two volumes will be given for each hundred boys. All that is necessary to obtain these volumes is that the head or assistant master should write to us. No application will be refused, as our object is to encourage the study of scientific literature by the youth of Great Britain.

A Common Cold

is the most prevalent of complaints and yet it has never been clearly defined. Most or very nearly all text books consider it merely as a cause of a number of different pathological conditions, or sometimes the *morbus* at hand is considered a phase or manifestation of what is so familiar among us—"taking cold." Dismissing further speculation along the line as not germane to the object now in view, we wish to call especial attention to the mechanism by which the effects of taking cold are brought about; and as theories and facts make up the bulk of our medical information, probably to theorise on this subject and draw a corollary of facts from the result would be the proper manner of procedure. Any portion or the whole of the body exposed to a cold draught for a varied length of time of course suffers from irritation, and immediately wires the ganglion or centre most intimately connected with that region, through the afferent nerves, and makes known the disturbance there. If the irritation is great (which we will assume to be a fact now) and the whole nervous system has to take cognisance of it, the disturbance is appreciated as an insult, and revenge is at once sought by sending out orders to have the secretions and excretions of the skin locked until peace is made. When the glands of the skin surrender their function, the ramparts of the citadel are taken, the skin becomes in a measure dry and chaffy, and loses its usual pliancy which is so essential to health. With the periphery thus in a state of blockade, it is not known by the economy at what time some of the more vital internal organs will suffer; so the nervous system trembles with fear, and we have a form of nervousness as a concomitant symptom of cold.

The Nervous System,

still trembling with fear and maddened by the insult of irritation, resolves to carry on the secretions and excretions by precipitating a double duty on the internal mucous membranes or serous membranes, as the case may be. So when the nervous system orders a mucous or serous membrane on double duty it revolts at the idea of having a vicarious function to perform, and even refuses to carry on its normal function. It is now that we have the dry stage of cold. When the nervous system locked the secretions and excretions, it seemed not to realise the fact that it was at the same time locking in some of the venomous products of destructable metamorphosis which, so to speak, in a state of stagnation, undergo a sort of change and become irritating to the brain and nervous system, thus causing the dull lethargic feeling and indifference to mental and physical exertion, and the aching pains in the limbs. After a while the mad internal membrane yields to its higher authority, the nervous system, and being overburdened by hyper-secretion and hyper-excretion, soon ceases to do its work physiologically and passes into a pathological state, and a catarrh is the result. Thus we may have coryza, pharyngitis, laryngitis, bronchitis, enteritis, etc., if a mucous membrane be involved; pleurisy, pericarditis, etc., if it falls on a serous membrane. Other troubles besides diseases of mucous and serous membranes are brought about by cold, but it is not our purpose to go minutely into them now. In treating a cold, just bear in mind the mechanism by which it was brought about. The nervous system is willing to compromise on almost any plan which includes removal of the offending locked-up excretions. Diaphoretics (medicines that promote insensible perspiration) proposes to do that, and on their administration and promise, the nervous system unlocks the pores of the skin, and equilibrium is restored.

In the presence of Contagious or Infectious Disease,

the germs floating about, or in some way gaining access to the individual near by, find their way into the body, and there a struggle takes place between them and these cells that are attacked by the invaders. Now begins a struggle for supremacy. The cells close around the attacking hosts and endeavour to destroy them and carry them off, or at least to prevent the further ingress of the bacteria. If the cells are victorious, they devour the germs, carry them away, and thus the individual escapes the disease. But if the germs increase too rapidly, and by the secretion of the poison or ptomaine from the bodies cause the death of the cells, then sickness results. In this case the accumulation of these carrier cells that are killed by the germs results in suppuration, for the cells of pus are but the white blood corpuscles, leucocytes, or phagocytes, when dead. As heat increases the motion of these carrier cells, and also their protective activity, the rise of temperature that precedes and

accompanies suppuration has been looked upon as an attempt on the part of nature to assist the activity of the cells and to destroy the invading bacteria.

Immunity from Second Attacks of Certain Diseases,

as well as the protective influence of certain inoculations and vaccinations, has never been clearly understood, although various explanations have of late been offered. In all probability, although this is but a theory sustained by analogy, after recovery from the contagious disease, usually occurring but once, the bacteria are supposed to secrete some morbid virus that hinders their own life, just as animals produce carbolic acid which is poisonous to them, or the yeast-fermentation produces alcohol which stops the growth of this fungus. In the same way, after these attacks, the cells of the body are supposed to contain some substance that resists the second attack of those organisms. The strength and duration of this immunity differs in individuals. Of course, the ability of these cells to struggle with bacteria is lessened in weakened individuals, and hence, for example, it is very probable that the lowered vitality caused by being chilled below the recuperating point invites an attack of pneumonia or some other disease, not from the mere chilling, but from the weakening of the strength of the cells. In hereditary diseases the predisposition plays an important rôle. We thus see that before Nature succumbs or yields to what has been very wisely called an "attack" of a disease, she uses various means of defence—and, fortunately for us, often comes off victorious.

The Horrors of the Highway

are descanted on in the *Lancet*, in reference to the cruelty of omnibus traffic. Our contemporary complains, that the strain imposed on the horses is sometimes appalling to witness, and hardly a week passes without numbers of them sinking under their load and dying where they fall. Twice last week, between Sloane-street and Piccadilly, a horse might have been seen to succumb on the incline, and after a few convulsive heart-heaves to breath its last. The animals are as powerful as can be procured. But the omnibus which they are made to drag, is a ton in weight before a single passenger enters it, and when it is full—fourteen outside and twelve inside, often with heavy packages in addition, the driver and conductor bringing the total up to twenty-eight—some notion of the exertion required to pull it at a brisk rate uphill may be imagined. Nor is this all. The incessant stoppages imposed by passengers who get up or down along the route, when half a minute more might bring them to a point where the vehicle pauses by regulation, add enormously to the strain exacted from the long-suffering animals. At the briefest of intervals they have to put on a fresh spurt, often on a slippery wood pavement, simply because some thoughtless "fare"—possibly on his or her way to an anti-vivisection meeting—will not take the trouble to wait till the 'bus "stops by nature." Our contemporary has been very moderate in its charges. Instead of a ton, the light omnibuses weigh from twenty-four to twenty-five hundredweight, and those fitted with "garden seats" rarely weigh less than thirty-two hundredweight, or considerably over a ton-and-a-half. This with a full complement of passengers brings the load up to about three-and-a-half-tons—a fit load for two horses on a greasy road. The remedy we would suggest is lighter vehicles, a thing easy of accomplishment, and the Continental system of only taking up and putting down passengers at certain points, where a bureau should be established for the issue of tickets.

The Hereditary Transmission of Mutilations

has just been the subject of some remarkable evidence. Mr. A. J. S. Shiddell, of Lexington, Ky., U.S.A., selected a pair of white mice for the experiment, on account of the rapid succession of generations, as they breed every thirty days, and when thirty days old are able to reproduce themselves. He kept these mice by themselves, and took their young and clipped their tails off. When they were old enough to breed, he selected a pair from among those with clipped tails, and performed a similar operation upon their offspring. After the seventh generation, some of the mice were born without tails; and, after a few more trials, a breed of tailless mice was firmly established. The process was then reversed, by mating an ordinary tailed mouse with one of the tailless breed; and, after a number of generations, the breed of mice with the usual caudal appendage was once more obtained. Incidentally to these experiments the "in and in" breeding of the mice was continued through ninety-six generations, all the sickly and defective animals being destroyed, and only the best specimens selected to continue the race. The result was the production of a pure-blooded animal, much larger and finer in every way than the original pair. These experiments are apparently trustworthy in every respect, and are of such importance from a scientific point of view—especially in their bearing upon the theory of evolution—that we hope they will be confirmed by repetition by one or more independent investigators.

A Simple Electrical Device

for preventing caterpillars crawling up trees appeared recently in our columns, but. on reading the paragraph, we find that a very important omission was made. It was suggested to run a copper and a zinc wire (galvanised iron wire would probably also answer in place of the zinc) around the trunk of the tree, about half or a quarter of an inch apart. But an essential feature is to place underneath the wires a piece of blotting paper or cloth moistened with salt water. In crawling up the trees the caterpillars must cross both wires at once, which will probably give them a sufficiently powerful shock to make them prefer some other tree. A paper moistened with salt water will keep moist, except in very dry weather. No doubt, when the caterpillars become sufficiently well educated in electrotechnics, they will crawl over these wires obliquely, so as not to touch both at once, and will then be rewarded by having the whole tree for themselves. A similar method was used many years ago by naturalists to imprison small, crawling animals for examination, without having to cover them. They were placed on a silver coin, surrounded by a circle of copper wire, the whole being placed on a piece of moist paper, the two metals and the moist paper forming a galvanic cell. When the animal attempts to crawl away from the coin, it comes in contact with the copper wire, whereby it short circuits the battery, and receives a shock which causes it to retreat, thus confining it to the coin.

Are Mackerel Blind?

is the question that has appeared in the columns of a seaside contemporary. Our readers will be indebted to Mr. Matthias Dunn, of Mevagissey, Cornwall, for his excellent theories on the subject. He says:—"One great reason for mackerel being considered blind was the fact that on grounds where thousands of mackerel have been caught in nets night after night, no mackerel could be caught in the day, although the most tempting baits had been towed through these waters from morning until night. But the reason for such circumstances was not far to seek. unlike the Mackerel,

pilchard or the herring, when feeding by night, seldom, if ever, feed by day. Again, another reason given for mackerel being sometimes blind, is the circumstance that fishermen often see mackerel rippling the surface of the sea when none can be taken with the hook. This also may be accounted for from the probability that at such times the mackerel were either feeding on the larvenal forms of the crabs, which in their first stages exist on the surface of the sea, or on very young fish, such as herrings or sprats, just after they have broken the egg, and this food is preferred before any other." But, instead of looking at their preference for certain food as the cause of failure to attract the mackerel, the fisherman sought for the cause in the eye of the creature, and, sure enough, there he found a most extraordinary contrivance on which he made another mistake.

In the Adipose Eyelids of Fish,

which are composed of two transparent skins, and are found in the front and at the back of the eye of all mackerel, and cover fully one-third of the entire organ, the fisherman found the supposed cause of his troubles. "These adipose lids, no doubt, supply two wants in the life of the animal; first, in protecting the eye of a creature which is at times necessitated to dart at the rate of fully twenty miles an hour, through a watery element often containing portions of solid matter which would injure the eye (hence these lids are like the glass protectors used by the human species for their eyes), and its second object seems not too clear, but I believe it is this: Mackerel are among the most voracious creatures I am acquainted with, and, I believe, destroy more sea life than either the whale or the shark, but a check is naturally provided in the eyelid against this extreme destruction of life, for as the body puts on flesh by continuous feeding, nature secretes fat between the lids on the skins of the eye, so that the vision of the creature is often restricted in such a manner as to deter it from dealing such destruction as it otherwise would."

Shade Plants,

such as can be used to cover the ground beneath trees where grass will not grow, are often inquired for. In addressing the Association of American Cemetery Superintendents at Chicago last autumn, Mr. Eurich, of Toledo, Ohio, said that he had experimented successfully with two "sod-forming" plants. Herniaria glabra and Veronica repens. The first-named, he explained, "is a moss-like, creeping plant which covers the ground in a very short time, and surpasses a grass sward in beauty. A strip of ground was planted in April with one hundred such plants set apart, and in less than two months the entire surface was covered closely. The plants were thinned out so that we obtained more than twice the original number, and an adjoining new piece was planted with the same result. This procedure was repeated in August, and before winter set in in we had a beautiful greensward of Herniaria growing. A very cold winter followed, and the plants were tinged slightly brown, but by April were again charmingly green. H. glabra will thrive in any soil in the open sun or in the shade." Veronica repens, the speaker said, "has somewhat larger leaves of shining green and generally the same characteristics as Herniaria glabra. A grave mound planted with it in August was completely covered by fall, and with a slight protection during the winter was brighter and fresher than the mounds covered with myrtle (Vinca) and ivy." The special feature of this plant is that in May it is completely covered up with very light blue flowers as low as the plant itself.

Light is Essential to the Creation of Colour

in flowers, as everyone familiar with the subject knows. The most gaudy blooms and the most brilliant foliage if kept in the dark or overshaded will become pale and almost white. This fact shows the presence in the plant of some chemical agent which is acted upon by the actinic rays. To some extent this chemistry of nature is understood by florists, who, by the use of chemical manures and other means, strive to take the greatest advantage of it. For instance, it is a common practice to mix alum and iron filings with the soil in which certain plants are grown in order to bring out special colours. The bluish-tinted hydrangea is the result of such treatment. Salts of iron, or sodium phosphate, added to the soil turns the crimson of the peony to violet and produces blue hortensias. According to Dr. Hanson, who has studied the subject very closely for many years, there are only three distinct pigments to be found in flowers—setting aside the chlorophyl, which forms the green colouring matter in all plants.

These Colours are Yellows, Reds, and Blues.

The yellows are mostly in combination with the plasmic sap, while the others exist chiefly in solution in the cell sap. The yellow pigment forms an insoluble compound with fatty matters, and is termed lipochrome. Orange is formed by a denser deposit of the yellow, and the colour in the rind of an orange is identical with that found in many flowers. The red in flowers is a single pigment soluble in water, and decolourised by alcohol, but capable of being restored by the addition of acids. Lipochrome combined with this red pigment produces the scarlets and reds of poppies and of the hips of hawthorns, but the varying intensity of reds in roses, carnations, peonies, and other flowers, depends on the presence of a greater or lesser quantity of acids. The blue and violet colours are also decolourised by alcohol, but reddened by acids. Florists have already succeeded in producing a very large scale of unusual colours in flowers, and, according to the *Horticultural Times*, there seems to be very good grounds for believing that it is possible so to manipulate Nature that she will produce blossoms of every conceivable tint and hue.

A Possible Cause of the Late Cold Weather

is sent us by Mr. E. Kennedy. He inquires:—"May not the heat of April 1st to 16th, 76 degs. highest, and 24th to 27th hail, rain, and snow; also Friday, June 10th, 89 degs., and Monday morning, 23 degs., or 9 deg. of frost on the grass, be due to the sun spots. If a beam of light or heat expands as it advances, could not the reverse be expected where there is an absence of such? Knowing that sun spots are caused by an an explosion, say gas, would it not cause the heated photosphere to rise irregularly in a sort of a circle after the style of a crater? As the influence of this hill of heat was felt upon the earth, would it not raise the temperature exceptionally high? Also after having passed the hill of heat, and coming to a perfect absence of such, might cause such a large fall of temperature as 66 degs.? It seems to me the only way to account for such a sudden fall; also the fall and recovery would vary with the size of sun spot. All of us must have noticed that during these cold periods, even though the sun be shining in clear blue sky, his light seems unaccountably diminished, from the ordinary glare of a June sun. No doubt, early in July, having passed from this influence, extraordinary heat will follow as we ascend the hill of heat the other side of the sun spot. I grant that an extra push from the sun by its extra-heated, expanding photosphere would cause, as already stated in SCIENCE SIFTINGS, an instantaneous push on the surface of the earth.

GLEANINGS OF THE GLOBE.

THE pendulum was first attached to the clock by Huyghens in 1656.

PROF. HUXLEY says that an oyster is a far more complicated piece of machinery than the finest Swiss watch.

THE density of population is greatest in Europe, where it averages ninety-seven to the square mile.

IF a well could be dug to a depth of forty-six miles, the air at the bottom would be as dense as quicksilver.

AT Quito, the only city in the world in the line of the equator, the sun sets and rises at 6 o'clock the year round.

THERE are 512,407 telephones in use in America requiring 266,456 miles of wire, which, on an average, allows a trifle over half a mile of wire to each instrument.

GALLIUM melts at 86° F., or less than the heat of the hand. When once melted, it remains fluid even if cooled far below this temperature ; but if touched with a piece of the solid metal, it solidifies at once.

IN Sicily a wind is called a sirocco because it is supposed to blow from Syria. It is fatal to vegetation, and destructive to mankind, especially to strangers ; it depresses the spirits in an unusual degree, and suspends the power of digestion.

IF the speed instead of the load of freight trains be increased, says a German engineer, from fourteen to twenty-eight miles per hour, the expenses per car mile at the higher speed would be one-fourth less for repairs and only one-fifth more for fuel.

THERE will be a great demand presently for fresh country air, and those of our readers who can afford to indulge in it will do well to apply for the Great Eastern Railway's list of farm-house and country lodgings in Essex, Hertfordshire, Cambridgeshire, Suffolk, and Norfolk.

A COMMON house-spider fell from the ceiling upon the face of Mrs. Annie Krozen, who was admitted last month as an inmate of a Canadian workhouse. A few hours later her face began to swell, and soon she lost the sight of one eye—the left. The next day her right eye became affected. In two days she was totally blind.

COPPER and german silver wire ·002 inch in diameter, of which it takes ten miles to weigh a pound, is used in the delicate receiving instruments for ocean cables, testing galvanometers, etc. Small as the wire is, it is wound with two layers of silk thread smaller in diameter than the wire. The wire is made by drawing through drilled diamonds.

AN instrument consisting of a series of strings or other bodies, each capable of entering into sympathetic vibration in response to various sounds of specific frequencies, has been applied to determining the rate of motion of a railway train, steamship, or other moving object carrying a whistle or syren of known pitch. There is no reason why the method should not be a successful one.

A NEW fibre, the pulp of which is said to be equal to that made from Esparto grass, for the manufacture of paper, has been discovered by Mr. A. Westin Hoyles, C.E., of Hyde, Ifield, Crawley, Sussex. The fibre is of annual growth, and the price compares favourably with other sorts on the market. Mr. Hoyles, who is a member of the Academy of Inventors, Paris, has been awarded the gold medal and first-class diploma for his discovery and invention.

IN some condors the expanse of wing is 14 feet, though the average is about 10 feet. They live on the summits of mountains in air so rare that men's vitality is reduced so that they cannot stand. The condor sits on its eggs seven weeks. It nourishes its young for a year before allowing them to leave the nest. It has a swift flight, a keen eye, and can adapt itself to the regions of perpetual snow or the tropical gardens at the base of mountains.

THE alleged power of camphor to awaken seeds or stimulate their germination has been shown by the experiments of M. Henry de Varigny to have no real existence. Various kinds of seeds were shown in sand saturated with water containing camphor, as advised by horticulturists, and the germination of all was slower, instead of more rapid, than that of similar seeds in water without camphor. Germination was even retarded by camphor vapour in the air, the water having no camphor.

LONG heads are usually associated with the possession of great intellectual strength and mental capacity. Herr D. Ammon, however, who made examination of the cranial capacity of 5,000 soldiers at Baden, the results of which he communicated to the German men of science at Heidelberg, is of the opinion that the size of the skull depends almost invariably on the proportions of the body. Tall men he found to always have long skulls, or skulls of medium length, whereas the short, fat men, as a rule, had round, flat heads.

THE difficulty in conveying to the judge, in electrical cases, a clear idea of the meaning of technical terms, resulted in the preparation of quite a collection of physical apparatus in a recent American case, in order that each step of the argument might be illustrated. It has been suggested that such permanent models might be useful in English Courts. We trust, however, that nothing of the kind will be required. Electricians in England, we hope, intend to supply the public need, and not feed the legal greed.

THERE is no certainty in any computations in regard to the time that the sun will continue to give light enough to sustain life upon the earth. The temperature of the internal mass of the sun is only a conjecture. The temperature of the photosphere has been estimated by various observers at from 3,000° to several millions. One authority estimates that 18,000° F. is probably nearer the truth than the extremes. From the radiant heat of the sun as observed on a given surface of the earth is computed the radiation in all directions throughout the sun's sphere. With this as a divisor, and the assumed units of heat held in the sun at some assumed temperature with the sun's mass as a dividend the time is obtained. This has been estimated at about 10,000,000 years, in which to wind up the age of life on the earth. Sir Robert Ball's observations, recently published in our columns, are of interest in this connection.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 35.

133.—What is a chemical element?

Substances that are incapable of being split up by any known means into two or more substances that are in any way distinguishable from one another are described as chemical elements. Chemical experiments, and reasoning based on them, indicate the simplest form in which the different elementary bodies can exist. Since, however, the capabilities of experiment have been by no means exhausted, the reasoning referred to is still largely of a tentative character. And as the science of chemistry advances, the number of substances believed to be of an elementary character may be either diminished or increased. It is held by some that eventually all of the so-called chemical elements will be shown to be built up of ultimate "helium" atoms, somewhat like ozone is built up from atoms of oxygen. Others suppose, with Lord Kelvin, that the elements we now know may be portions of the universal ether endowed in each case with such vortex motions as render their differences permanent for so long as the existing order of Nature is maintained.

134.—How is light propagated through space?

Since it is impossible to conceive of action at a distance without the intervention of any medium, we may admit that light must consist either of excessively minute corpuscles projected in straight lines, or of motion in a universal medium, pervading, not only transparent substances, but also the airless space embracing our stellar system. The latter hypothesis is now universally adopted; and although there are several kinds of motion in the luminiferous medium or ether that might be shown to account for some of the phenomena of light, the opinion that this motion consists of transverse waves, somewhat similar to the transverse waves that can be produced in material solids, is the only one that has gained support from every experimental investigation of light motion that has been hitherto carried out. A light wave propagated freely from any point through space consists of a continually enlarging spherical shell of etheric disturbance—the disturbance taking place in the direction of a tangent to the curved surface, and in any azimuth indifferently. The intensity of the etherial disturbance decreases as the surface of the shell of disturbance increases. The thickness of this spherical shell is constant, being some very small fraction of an inch, more or less, according to the colour of the light.

135.—What are the distinctive features of the four known states of matter?

Eight states of matter have been distinguished by Maxwell. Three can be very clearly and perfectly differentiated. These are (1) the perfect solid, in which, although the component atoms may have some vibratory motion, they do not depart permanently from their fixed mean positions. Possibly the only perfect solids are the ultimate *atoms* of matter; for under the application of sufficiently great stress, substances that are, under ordinary circumstances, perfect solids—iron or gold for instance—behave as liquids. (2) The liquid state, which is never perfect. Indeed, as has just been stated, it is difficult to draw the line between liquids and solids, except under specific conditions of stress. And it is worth remarking that by mixing, say resin and turpentine in various proportions, the change from the solid to the liquid state can be shown to take place by practically imperceptible gradations. Theoretically, a liquid cannot be in equilibrium unless the stresses acting upon it at every point are equal in all directions. (3) Superadded to this characteristic of a perfect liquid, a gas is endowed with the power of expanding indefinitely, so as to exert a pressure on the boundaries of any containing vessel, however large. The fourth state of matter referred to by the querist is probably that discovered by Prof. Cookes. It is not, however, essentially different from the gaseous state. It might be better to mention the luminiferous ether as the fourth state of matter, since on Lord Kelvin's authority it is held that matter and ether are closely related to one another.

136.—What is the distinction between a gas and a vapour?

Gases may be condensed to the liquid form by the application of pressure, together with cold; but vapours are distinguished by being condensible by pressure alone, without any reduction of the temperature.

137.—How should fuel be burned to avoid smoke?

It is only necessary that the quantity of fuel in the grate and the proper supply of air should be kept constant, and that the quality of the fuel should be uniform throughout. The ordinary method of using coal is crude, and necessarily wasteful. The composition of the fuel and the rate at which it burns is always changing, from the time at which the fire is replenished to that at which the whole of the volatile matter is driven off from the fresh charge of coal. Meanwhile the supply of air requisite to complete combustion fluctuates from minute to minute, and it is practically impossible to regulate it properly. Either too great or too small a supply of air may cause the production of smoke, and it is, therefore, to be strongly recommended that fuel which burns in a more uniform manner than coal, for instance, that coke, gas, or hydrocarbon oil should be used in preference wherever possible.

138.—What is electro-plating?

Electro-plating is the result of local decomposition of a metallic salt at the surface of the article to be coated. The solution, which may be sulphate of copper, sulphate of nickel, or cyanide of silver, etc., is decomposed by the passage through it of an electric current, and the metal is precipitated on the negative pole—that is, of course, on the article to be plated. It is necessary that the article to be plated should be very perfectly cleaned, in order that the metallic molecules may be precipitated in all of its interstices and thereby secure the adhesion of the electro-deposited film. It is also found that by burnishing the surface continuously while the process of deposition is carried out, a more close, and at the same time uniform texture can be conferred upon the metal than in any other way. This constitutes Elmore's process for the manufacture of tough copper ware.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

145.—How is electrical radiation produced ?
146.—Why does the intensity of light decrease as the square of the distance traversed ?
147.—What is the most rational supposition regarding the condition of matter at the centre of the earth ?
148.—What is the difference between a gas at very high pressure and the same gas liquified by cold ?
149.—What is calorescence, and how is it produced ?
150.—What is protoplasm ?

YEARLY TIDES.

At a recent meeting of the Engineers' Club of Philadelphia, Mr. W. S. Auchincloss read a paper on yearly tides. The author stated that he proposed to show that confined bodies of fresh water are subject to yearly tides of greater or less magnitude, depending upon the nature of the basin or upon the strata to which they are confined, and upon the effect of evaporation if in an open basin.

In March, 1885, we had occasion to sink a well near Bryn Mawr, Pa. Natural anxiety as to the permanence of the supply led us to observe the depth of the water at intervals of about ten days. It soon became evident that the water was receding. In 1886 there was a gratifying rise of the surface and a total gain of 12 feet. Our curiosity was aroused and we determined to study the law, if such a law existed, of this ebb and flow. These observations have been continued during the past seven years. We found that in normal years the surface of the water reaches its lowest level in December, rises until June. and descends during the autumn.

An examination of the amount of rainfall shows that while the amount of rainfall was as great or greater during the last half of the year as during the first, the level of the water in the well continually lowered. Atmospheric temperature had practically no effect, as the temperature of the water in the well is practically constant all the year round. The depth of the well prevented evaporation from its surface from having any effect.

The author believes that the true cause is the result of the influences of gravity and of the sun's attraction at different seasons of the year. When the sun reaches its furthest point south of the equator, gravity exerts its maximum influence on the waters of the northern hemisphere. The waters of the earth will be drawn into the minutest crevices and the surfaces lowered, but in June they will, in a measure, be released, and, under the influence of adhesion and friction, will be held at a higher level than during any other season of the year.

Data obtained from the government records, showing the depth of water in the great lakes, show that there is a similar rise and fall, the range of yearly ebb and flow being from 12 to 15 inches in our northern lakes. So far as we are aware, no data exists for the small lakes. More extended research will, we believe, secure as complete a recognition of yearly tides as physical geography has always accorded to the phenomenon of daily tides.

The author presented two diagrams, one of which showed the rise and fall of the water in the well, covering a period of seven years, and also the northing and southing of the sun for the same period.

WHY BROWN BREAD IS BAD.

In a recent article the writer propounds this startling conundrum : "What part has science in the making of bread ? To what extent has this staple article of food been improved and benefited by the immense strides made in scientific knowledge, applicable to almost every other article ?" With an equal show of wisdom might not the same question be asked in reference to the artificial covering of man ? To what extent has the wearing apparel of man been "improved and benefited by the immense strides made in scientific knowledge ?" Without being tedious we might name one small benefit. One hundred years or less ago, when a delicate and sensitively constructed man or woman put on a suit of woollen underclothing at the period when winter commenced to make itself felt, it was equivalent to voluntary infliction of six months' self-torture. The irritation caused by the rough material of which the clothing was made was of the most aggravating nature, requiring the constant application of a counter-irritant in the shape of a vigorous set of finger nails or anything else that would scratch. Now, the most sensitive-skinned individual can don a woollen undersuit with assurance of complete immunity from unpleasant irritations of the article.

So also has a beneficial change been wrought in flour. Then, the unwholesome and irritating properties of the wheat were in a large measure retained in the flour ; now they are all eliminated, and the flour made pure and wholesome. But those very impurities should be retained in the flour, argue our magazine writer and other philanthropists of the same school, because, forsooth, they are healthy, and necessary in preventing dyspepsia, constipation, and the like. Does it ever occur to those people that if wheat bran, germ, etc., possessed one-tenth of the curative virtues claimed, what a wonderful aid to materia medica would the offal of a single one of our first-class flour mills be ? If the wastes of the flour mill are a panacea for dyspepsia and kindred or sympathetic affections, each of the flour mills is an unconscious medicine factory, or at least prepares the material for making a most valuable medicine. Why has that not been thought of, and arrangements made for converting it into a medicated food, to be eaten by those who need it, and let alone by those who do not need it ?

But, after all, does it possess any virtues of that kind ? Is it a specific for either dyspepsia or constipation ? Will it prevent or cure either disease ? The answer is that it has never yet been successfully demonstrated that it will. In certain cases it acts as an irritant to the bowels, but Epsom salts will do it just as well, and with more certainty. There are other constitutions on which it has the opposite effect on the bowels ; that is, it tends to loosen one and bind the other. As for the stomach, it is extremely doubtful if it ever has or ever will be benefited by the use of bran or any other kind of food containing insoluble and indigestible matter. It is in violation of Nature's laws. The claim is an imaginary one.

Our magazine writer further says : "Separating the bran from the flour became fashionable at the beginning of the present century. This fashion created the dental profession, which with its large manufacturing industries, has grown up within the last two generations. It has reached its present magnitude only because our food is systematically deprived of lime, of salts, and phosphoric acid, the creators of nerve, bone, and tissue, which especially are so signally absent from our modern white bread." That is certainly a most damaging charge, if true ; but is it true ? Where is the evidence to be found ? If we keep on eating good white

and pure bread, we will soon be a toothless race, if it be true. By the way, other scientific writers say that we will ere long be a bald-headed race. Children will be born minus all hair germs, and will ever have heads as bare and smooth as when they first appear in the world. Our critic of white bread must have overlooked that important fact, or the present and prospective bald-headed condition of man would have been charged to unwholesome bread also. One proposition is just as reasonable as the other.

Then, again, immense manufacturing establishments have been built and vast fortunes made in the proprietary medicine business in the past two generations. Why not make the case stronger by charging that to the bold, bad millers? If the evil is potent enough to destroy teeth, it might just as easily bring about many of the other ills of humanity. Is it true that the people of this generation are more toothless than were the people of former generations? Is it not true that while the absence of teeth was as marked in former generations as now, people that once lost them did without them for the remainder of their lives, while now it is the fashion to have a set of false teeth even before the natural ones are gone.

Is not the building up of the dental profession an evidence of human progress, rather than of decay? The children of this generation, whose blood is entirely free from destructive taints, start in life with as perfect and finely-developed teeth as ever filled the mouths of children in any age of the world. And if the passions are not too early indulged in, and general health remains good, the teeth will remain with them to old age. It is not true, it cannot be conclusively shown, that the flour of to-day destroys the teeth.

Again, it has never been demonstrated that the impurities taken out of the flour during the milling process are "the creators of nerve, bone, and tissue." The weight of the evidence, so far as presented, is against that theory. Where is the horseman that would dare feed wheat bran to his favourite to make bone and nerve, and insure endurance. None would dare do it; and yet if it were true that wheat bran or flour offal, as a whole, possessed those virtues, no better feed could be given a horse to insure strength, speed, and endurance. A common work-horse cannot be sustained on bran feed. Mill-stuff makes good feed for milk cows in that it increases the output of milk. It will make tissue of a soft and flabby kind in cattle and swine that are being fed for butcher's stock, but must be followed by corn or other substantial food, to give firmness to tissue thus formed. It does not create nerve, bone, nor tissue, of a valuable sort, nor is there any evidence that, except for the small portion of starch and gluten that is always mingled with the mill-stuffs, any tissue would be formed by its use as food. On the contrary, the conclusion that there would be none is both logical and irresistible. Briefly summed up, these impurities may contain medical properties valuable in certain diseases, but, if so, should be extracted, and used as medicine, and not as food.

The writer to whom we have referred says: "There is ten times as much science employed in the making of beer" as there is in making bread. Perhaps there is, and if he would follow that scientific course, he might find more causes of human ills than in the unscientific method of making flour. The beer making science is practically behind the scenes, in the dark, resulting in unwholesome adulteration; in making, by artificial means, the greatest quantity of beer out of the smallest quantity of actual beer-making material. In view of the large quantity of beer used as a beverage among the people, why may it not be responsible for some of the ills that are charged to bread?

Science has done much for flour making, as is in evidence on every hand, and operates in the broad sunlight of day, not for the purpose of scientific adulteration, but to make an absolutely pure food. Instead of being in league with the doctors or the devil, the millers are bending their energies, using their resources, exhausting all knowledge, scientific and otherwise, to do just what scientific beer makers are trying to avoid doing, to make a pure wheat flour, free from all natural impurities, free from adulteration of every kind, and containing all the wholesome bread-making properties found in the wheat; and they now come very near doing it. Such is the difference between scientific flour making and scientific beer making.

A THEORY OF THOUGHT TRANSFERENCE.

The process carried out by Nature in exercising the marvellous functions of the brain may not always remain a secret buried behind a wall as impenetrable as the origin and function of life itself. It would seem, however, that there is room enough for exploration in the actions of the brain with relation to its own individual environment without plunging into a field so full of charlatanry where the data are usually open to suspicion as telepathy. The ether hypothesis, now made to do a new service by Prof. Houston, is clever and ingenious, as indeed are the orthodox notions of the actions of this hypothetical medium in transferring heat, light, and electricity. At the same time there is offered an opportunity for a more rational working hypothesis of the functions of the brain from a chemical rather than physical standpoint.

The performance by the brain of its wonderful function, thought, not only involves an expenditure of energy, but there is also a consumption of food as fuel to deliver the energy—a decomposition and reconstruction of the brain itself seems to be part of the process. Chemical dissociation and re-aggroupment of the atoms is a more tangible subject of examination than an exploration of ether waves, and has a solid substratum of fact to endorse its acceptance. True, the chemical reactions themselves may be simply forms of motion. If it were possible to construct a microscope which would make sensible the individual atoms, it might be found that differences in chemical structure are merely differences of physical arrangement, and that the atoms are grouped according to the character of material into different systems in constant relative motion, and held in their orbits by a law which controls the stellar universe. This also is a bold hypothesis, and smacks of alchemistic transmutation, but it offers a simple line of investigation when the microscope shall have been brought to its highest stage of perfection. From any standpoint, investigation, or even speculation, promises to be more profitable in a subjective rather than in an objective line. Thought projection, theosophy, mind reading, and other forms of objective thought influence, can await their turn for investigation, both as to their reality and their origin, until it is found out how we are conscious of our own thoughts.

Thought transference by ether waves is Prof. Houston's latest theory, and we are pleased to be in a position to publish the full text of his bold speculations, extravagant as they appear. He writes:—"I have thought it possible that it might interest you to consider some rather wild speculations in which I have indulged for a number of years past, but which I have heretofore refrained from publishing. In these speculations, to which I was first led by a suggestion from a friend, I have endeavoured to correlate, to some extent, the phenomena of thought with grosser physica

phenomena. Although the suggestions I have to offer as a basis for a hypothesis of the mechanism of cerebration are confessedly incomplete, and, perhaps, improbable, yet I have concluded to place them on record as of possible interest to the scientific world.

"I am, of course, aware of the fact that the psychical operations of the brain are by no means understood. It is generally believed, however, that the seat of psychical activity is the cerebrum. The manner in which the brain acts to produce, record, and reproduce thought is unknown, and will probably remain unknown.

"On the single assumption, however, that cerebration or thought, whatever may be its exact mechanism, is accompanied by molecular or atomic vibrations of the grey or other matter of that part of the brain called the cerebrum, I would propose the following hypothesis to account for telepathy, mesmerism, thought transference, hypnotism, and other cognate phenomena.

"Postulating the existence of the universal or luminiferous ether, which is now generally accepted in scientific circles, and bearing in mind the fact that this ether passes through even the densest matter as easily as water through a sieve, it follows that the brain atoms or molecules that are here assumed as the cause of cerebration are completely surrounded by the ether. Now, since the ether is a highly elastic, easily movable medium, it would follow that thought or cerebration, if attended by vibrations, must necessarily develop in the ether wave motions, which have the brain atoms or molecules for their centres. In other words, the act of thought or cerebration necessitates an expenditure of energy, because it necessitates the setting in motion of these assumed atomic or molecular brain particles.

"The exact nature of the motions that are assumed to attend an active condition of the brain must necessarily remain unknown as long as we are ignorant of the exact nature of the mechanism that is moved. But, if an active brain evolves thought because something is set in motion, it, of course, follows that a brain absolutely free from producing thought must be at rest, so far as that kind of motion is concerned. An absolute freedom from thought in a healthy brain is most probably a condition that seldom exists: relative rest, however, must be quite common.

"That the brain cells of the grey or other matter involved in the production of thought can be caused to assume certain groupings or relations towards one another would appear to follow from the ease with which that curious function of the brain called memory permits it to readily recall past peculiarities in the to-and-fro motions. By continually repeating certain trains of thought, as in study or repeated observations, the peculiar motions required to produce such thought are probably given a set or tendency to form more or less permanent groupings. When, therefore, the brain is moved or played upon, so to speak, these motions recur and certain memories are awakened.

"How may these motions be produced? The answer would certainly appear to be both from within and without. It is, perhaps, possible that the flow of blood to an active brain, which, as is well known, attends all active cerebration, is not only for the purpose of nourishing and rebuilding the organ, but also for affording the purely mechanical force, that needs but to touch this marvellously attuned organ to awaken the thoughts already impressed thereon, or to sit in judgment on new combinations never before presented to it.

"I will suggest an explanation later on as to how these impressions may possibly be excited from without.

"Whatever be the origin of these vibrations, or however excited, energy is required to be expended in producing them, and, as the brain worker will readily acknowledge, the expenditure of such energy often calls for an enormous expenditure of nervous force.

"Cerebral energy, or energy thus expended in producing thought, is dissipated by imparting wave motions to the surrounding ether, and such waves are sent out in all directions from the brain, possibly in greater amount, or of greater amplitude from some of the brain openings, as, for example, those of the eyes.

"Although there are no absolute proofs of the existence of the molecular or atomic vibrations of the brain particles which I have assumed, such a movement, however, is far from being improbable, and, indeed, some facts known to the medical profession are far from being at variance with such an assumption. A certain amount of pressure on the brain arising from the pressure of the blood is necessary for its proper action. If this pressure increases beyond a certain value, as, for example, in cases of fractures of the skull, where a portion of the bone is depressed by the fracture, thereby producing a compression on the brain material all thought or cerebration instantly ceases; but when this pressure is relieved by the act of trephining, cerebration not only begins, but, curiously enough, generally goes on from the point where the patient left off when the injury occurred.

"Let us assume, then, that cerebral radiations or waves are given off from every sentient or active brain, and that these waves pass into the space around the brain something like the waves that are imparted to the air around a sounding tuning fork.

"The cerebral radiations are not so gross as those of sound. Their wave lengths are almost certainly much shorter. They are imparted to the universal ether.

"If such waves, which I would call thought waves or cerebral waves, be present in ether that fills all space, it will be interesting to inquire what phenomena they might be expected to produce.

"It being assumed that these vibrations take place in the ether itself, there need be no doubt or speculation as to the general nature of the waves themselves. They would presumably partake either of the nature of transverse or torsional vibrations.

"The commonest character of the vibrations which occur in the universal ether are the vibrations which are now generally recognised as transmitting the phenomena of heat, light, electric or magnetic radiations, viz., of transverse or torsional vibrations.

"An active brain may, therefore, be regarded as moulding the ether around it into thought waves that are spreading outward from it in all directions. In this respect it is not unlike a conductor through which an oscillatory discharge is passing, producing those waves which Hertz has so beautifully demonstrated as resembling the vibrations that produce light.

(To be concluded next week.)

Amateur Photographers' Competition.

We regret that, owing to the very large number of entrances for this Competition, we are unable to make the awards until next week.

"SCIENCE SIFTINGS" FREE OF CHARGE.

We want every intelligent individual to know of the existence of "Science Siftings." Our readers can help us in this way by introducing the paper to their friends, or by sending us the addresses of those they know, to whom we shall be happy to mail specimen copies free of charge. Furthermore, we will send

"SCIENCE SIFTINGS" FREE FOR A YEAR

to anyone who will send us three annual subscriptions of 6s. 6d. each, for themselves or friends.

LIFE ON OTHER WORLDS.

By Camille Flammarion.

The splendour with which Venus sparkles every night above us, the recent studies which have been made of the length of the rotation of this beautiful planet, the unexpected discoveries regarding our neighbour the planet Mars; the preparations which are being made at this moment to profit by its proximity, the progress realised in the spectroscope and celestial authority, all seem to concur to direct the attention of astronomers, philosophers, naturalists, and even poets toward the supreme question placed before the human mind by the spectacle of the universe—What is there in those distant abodes? Have we sufficient reason for admitting that these other worlds are peopled like ours? And if life has appeared in these lands of the skies as in our sublunar country, has it any resemblance to our own? In a word, are these other worlds inhabited, and if they are, do their citizens resemble us?

The question is much more serious, more vast, more complex than in some minds, even scientific ones, seem to believe. Without doubt one can dispense absolutely with any interest in it, for it is of no practical utility, and the actual generations are brought up in the belief in material interests and in the opinion that the exercise of the intelligence should consist, above all, in "money making"; that the mass of humanity can and should live without occupying itself in any degree, however small, with the marvels of creation? Why raise the eyes to Heaven? Why admire a sunset? Why contemplate a landscape bathed in the white light of the moon? Why listen to the whisper of the wind in the trees? Why love the silence of midnight? Why breathe the perfume of the rose? Nothing of that brings money. Time is money! Business! Business! Human beings, my brethren, that suffices you.

But there is an intellectual minority for whom native ignorance does not suffice. There are beings curious of the unknown. There are souls which think, which act, which seek. And this spiritual minority constitute alone the glory of humanity. It is to it that we owe the progress of the sciences, letters, and the arts: it is to its labours, to its aspirations, to its conquests that we are indebted for being no longer too nearly related to the gorilla and the chimpanzee, and for having raised Paris on the site of the ancient tertiary forests.

However, all those who think do not think alike, even on the special subject which is the object of this article. The greater number even judge it much too superficially. We wish to show here that the latest advances of science lead us to extend to the entire universe, to the infinite, the principles of life of which the earth represents only a minute application; that, on the one hand, terrestrial manifestations of life do not limit possible forms, and, on the other hand, that the actual epoch is but a wave on the ocean of ages.

But this is very serious for a newspaper article! It seems so, however, without really being so. The question is quite as worldly as if we were about to study in detail and from life the not uninteresting bodies of Aspasia, of Phryne, of Cleopatra, of Agnes Sorel, of Diane de Poitiers, or of Lucretia Borgia.

Our first object in studying other worlds is to know if they resemble ours. When we observe the moon or Venus, Mars or Jupiter with the telescope we naturally and instinctively seek first for analogies with the world which we inhabit. We seek to determine the conditions of inhabitancy, the climate, the length of night and day, the meteorology of each world, with the preconceived idea that the degree of probability in favour of the existence of life is proportionate to the degree of resemblance to the planet which we inhabit.

We have certainly some right to reason in this way, because in what concerns life we know only that which exists around us. The direct observation of terrestrial facts leads us to think that an atmosphere identical with ours is necessary to life, that it requires also water identical with ours, a temperature neither too cold nor too hot, materials neither too dense nor too light, years neither too short nor too long—in a word, conditions identical or at least very analogous to ours. A world destitute of oxygen, for example, is judged by us radically uninhabitable, for the reason that if oxygen disappeared entirely from the terrestrial world, humanity entire would perish instantaneously. In the same way a world deprived of water—I mean of our chemical water composed of two parts of hydrogen and one of oxygen—is declared uninhabitable by the savants of the earth. The same exclusion would apply to a world destitute of carbon, etc.

Well, this reasoning of savants is the reasoning of fishes. Imagine for a moment two silvery whitebait at the bottom of a river flooded with sunlight talking together. Fishes understand one another very well despite their apparent muteness. One of them, who has more than once been nearly taken by the net, but who with a certain cunning recognises fishermen at once, assures his comrade that there is a world outside of the water. This one, perfectly familiar with the conditions of fish life and on the functions of the gills, easily crushes his enlightened adversary with the weight of his scientific arguments. "Live out of the water! What sensible fish would believe such chatter for a moment? Come, now! An oyster would not believe such tales. The shadows that we see passing on the banks cannot be living. They are optical illusions. Live out of the water! What a joke! Why water is essential to life, and good, fresh water, in spite of what that old salmon trout said the other day about journeying to the ocean and finding real fishes living in that salt water! Fie!"

A doctor of the Sorbonne could not have been more logical or more concise in his argument, although, doubtless, he would have expressed it in more elevated language. However, it is but just to admit that we are excusable for judging in this manner. We have studied the conditions of life on the earth and their limitations, and we do not readily divine how life can exist under other conditions.

However, a glance at the entirety of the terrestrial world warns us not to inclose our horizon in too narrow a circle. At the outset the immense difference between aquatic life and aerial life indicates the infinite resources of nature. Formerly, indeed, short-sighted naturalists taught that the depths of the ocean contained no organic life on account of the enormous pressure in those depths, which would be sufficient to cause the discharge of a cannon and also because of the obscurity which would prevent all molecular work. A curious person, wishing to have the last word, let down a plumb weight 1,000, 2,000, 3,000 yards and drew it up covered with living marvels, with ravishing molluscs of extreme delicacy, with graceful butterfly-like beings which lived there in perfect equilibrium in the mighty depths, playing the game of life in a light that they made for themselves, being phosphorescent! What a contradiction! What a lesson!

Life! Life! It radiates everywhere on the globe, from the black depths of the ocean to the white summits of the eternal snows; it trembles in a ray of sunlight, swarms in a drop of water, it fills the air with microbes; it multiplies parasites upon parasites to the detriment of life itself; it envelops all the globe with an endless net, which constantly

alters and improves itself; it shows itself in the earth, in the water, in the air, in the plant, in the animal, devouring itself rather than to cease to be; it overflows from all sides of the terrestrial coop too narrow to contain it, and we have the pretension to place bounds upon it! Fish that we are!

By what right shall we say to the vital energy that radiates in the universe, "So far shalt thou come and no further"? In the name of science? A complete error. The known is a tiny isle in the midst of the ocean unknown. The depths of the sea which seemed a barrier show themselves peopled with special life.

"But," comes the objection, "there is air, oxygen there also. Oxygen is indispensable. A world without oxygen is a world vowed to death, a desert eternally sterile."

Why? Because we have not yet seen beings breathing without air, living without oxygen? Another error. Even if we did not know of any that would not prove that none exist. But we do know of some. They are the anaerobies. These beings live without air, without oxygen. Still more, oxygen kills them.

In properly interpreting the spectacle of terrestrial life and the positive data furnished by study, it is plainly evident that we should enlarge the circle of our conceptions and of our judgments, and not limit planetary existences to a servile image of what exists here below. The terrestrial organic forms are due to the local causes of our planet. The chemical constitution of water and of the atmosphere, temperature, light, density, weight, are so many elements which have served to make our bodies. Our flesh is composed of carbon, azote, hydrogen, and oxygen combined with the state of water and of some other elements, among which we may mention chloride of sodium. The flesh of animals is not chemically different from ours. It all comes from water and air and will return to them. The same elements in small quantities make up every living being. The ox which eats the grass forms the same kind of flesh as man who eats the ox. All terrestrial organic matter is only carbon, combined in various proportions with hydrogen, azote, oxygen, etc.

But we have no right to forbid Nature to act otherwise in worlds where carbon does not exist. A world, for example, where silica would replace carbon, silic acid, carbonic acid—could it not be inhabited by beings of an organism altogether different from those existing on the earth, different not only in form but also in substance? In a world where chloride would dominate, would we not find chloric acid and all the fertile family of the chlorides fulfilling an important part in the functions of life? And bromide, could it not be associated with other formations? And why should we stop at terrestrial chemistry? Who has proven to us that these elements are really simple? Hydrogen, oxygen, carbon, azote, sulphur, why should not they be compound? Their equivalents are the multiples of a first:—1, 6, 8, 14, 32. And is hydrogen really the most simple of the elements? Is not its molecules formed of primitive atoms, whose geometrical groupings and varied associations constitute the molecule that we call simple?

One thing certain is that the marvellous revelations of the spectrum analysis do not argue in favour of unity of chemical constitution in the different celestial bodies, nor of an absolute unity among themselves; far from it. In our own solar system we find essential differences between certain planets. In the spectrum of Jupiter, for example, we find an unknown substance which manifests itself by a strong absorption of certain red rays. This gas, which does not exist on the earth, shows itself even more strongly in the atmosphere of Saturn and Uranus. On this last planet the atmosphere even appears, if we leave aqueous vapour out of consideration, to have no analogy with ours. Moreover, in the solar spectrum itself we find a substance to which has been given the name helium, and which we have never found on the earth.

The relationship of the planets among themselves is an undeniable fact, since they are all daughters of one father. But they differ among themselves, not only by location, position, volume, mass, density, temperature, atmosphere but still more by their physical and chemical constitution. And the point to which we call attention here is that this diversity should not be considered as an obstacle to the manifestations of life, but, on the contrary, as a new field open to the infinite fecundity of the universal mother.

When, then, our thought takes flight not only towards our neighbours, the moon, Venus, Mars, Jupiter, Saturn, but even to the myriads of unknown worlds which gravitate about the suns scattered in pace, we have no plausible reason for imagining that the inhabitants of these other worlds of the skies resemble us in any particular, whether in form or in organic substance. The form of the terrestrial human body is due to the elements of our planet, notably carbon. The terrestrial human form is derived from ancestral animals, from which it has gradually elevated itself by the continued progress of the transformation of beings. Beyond doubt it seems to us that to be a man or a woman there must be a head, a heart, lungs, two legs, two arms, etc. Nothing is less clearly demonstrated. If we are constituted as we are, it is simply because the prosimians had also a head, a heart, lungs, legs, arms, not by any means as elegant as yours, madam, but still of the same anatomy. And, little by little, we go back easily to-day by means of paleontology to the origin of beings. Thus it is certain that the bird has developed from the reptile by a process of organic evolution, so also it is certain that terrestrial humanity represents the summit of an immense genealogical tree, of which all the branches are brothers, and the roots of which plunge into the very rudiments of the most elementary primitive organisms.

All kinds of imaginable and unimaginable forms should people the multitude of worlds. Terrestrial man is endowed with five senses, or rather with six. Why should Nature have stopped there? Why, for example, should she not have endowed certain mortals with an electric sense? with a magnetic sense? with a sense of locality? with an organ capable of perceiving ethereal vibrations, of infra-rouge and of ultra-violet? Of a sense permitting one to hear at a distance, to see through the walls. We eat and digest like the grosser animals. Do there not exist worlds where the nutritive atmosphere relieves its inhabitants from so ridiculous a burden? The smallest swallow, the dusky bat itself has the advantage over us of flying through the air. Is not our world, where the man of the greatest genius, the most exquisite woman, finds himself or herself nailed to the earth like the common caterpillar before its metamorphosis, a very inferior one?

Well! Would it be so disagreeable to inhabit a world of perfume and voluptuousness where the flowers would be animated? where suns of many colours—the diamond joined to the ruby, garnet to the emerald and to the sapphire—would shine night and day—blue nights, scarlet days—in the glory of an eternal springtime; many coloured moons sleeping on the mirror of the waters, phosphorescent mountains, aerial inhabitants, men, women, and perhaps other sexes perfect in their forms endowed with multiplied sensibilities, luminous at will, incombustible as asbestos, immortal perhaps. At least,

n

liliputian atoms that we are, once for all let us be convinced that all our imagination is but sterility in the midst of the infinite, scarcely seen through the telescope.

And in the beautiful spring nights, when Venus sparkles with all her brilliancy in the midst of the sublime spectacle of the night, when we think of the unknown worlds that people space, let us be assured that they are, have been, or will be inhabited—their vital cycle not being necessarily identical with our own—but that an infinite diversity reigns in the fields of the heavens as in the gardens of the earth. There are humanities there which must be incomparably further advanced on the road to perfection than we are. Our earth, with all its political, religious, and social history, is only a minute; only a poor ant hill; only the flutter in a ray of sunlight of a gnat that lives a day.

THE USE OF SALT.

In all the range of the household materia medica there is no remedy half so valuable as common salt. Heated dry and applied to the outer surface over the seat of inflammation or congestion it will give almost instant relief; while applications of a strong hot solution of salt in water or vinegar acts like magic upon tooth-ache, ear-ache, neuralgic head-ache, and all that brood of distressing ills. For catarrhal affections and a sore throat a spray of warm water and salt is one of the standard prescriptious of the 'nose and throat" specialists. For hay fever and those other slighter forms of nasal sensitiveness that induce a constant sneezing, there is no remedy more quickly palliative than the vapour of heated salt and alcohol. Persons with tender feet will find them growing much less sensitive day by day if they treated them to a daily brisk rubbing with cold salt and water. Beside all this, salt is good for the stomach. A pinch of it in hot water, taken either just before or just after a meal, is a valuable aid to digestion; and a cupful of very hot salt water will sometimes quiet the most persistent nausea. Anything more that salt will do? Yes, the most grateful of all—cure the tooth-ache sometimes. A little girl who was told to put some in an aching tooth says, "I just put in a little salt, and in a few minutes I felt the naughty aching nerve curl right down and go to sleep."

WHEN DOES DEATH BEGIN?

None knew better than Daniel Webster how to employ wit in lieu of argument. He was once retained to defend a will. A physician made affidavit that the testator was struck with death when he signed it.

Webster subjected his testimony to a most thorough examination, showing, by quoting medical authorities, that doctors disagree as to the precise moment when a dying man is struck with death, some affirming that it is at the commencement of the disease, others at its climax, and others still affirming that we begin to die as soon as we are born.

"I should like to know," said the opposing counsel, "what doctor maintains that theory!"

"Dr. Watts," said Mr. Webster, with great gravity.

"The moment we begin to live
We all begin to die."

The reply convulsed the court and audience with laughter.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

BABY'S BURDEN.

A Dr. Guster gave a German newspaper the brief, but pathetic, journal of a baby who, after thirteen days in this world, departed, leaving these reflections for our instruction:

First day.—Wonderful, heavenly! At last I am in this beautiful world! Who would have thought it, that one could breathe, freely breathe, and cry out what one thinks? I rejoice particularly in the sunlight and blue sky, in the fresh, pure air, with its coolness. If I could only see and feel all this splendour!

Second day.—O this horrible heat! I have been deceived. This air, this water, this light; how entirely different have I imagined it would be. But, patience, all will come right by and bye. The old woman who cares for me does not seem to understand me.

Fifth day.—Still no solution. If it goes on this way I can not hold out long. The whole livelong day must I lie buried in feather cushions so that I can scarcely gasp down a bit of fresh air. Two linen and one flannel binders, a little shirt, a flannel slip, a long cushion filled with feathers, in which I am wrapped from head to foot, over this a coverlet filled with feathers, the curtains of my crib drawn to, the room darkened with double curtains, the windows closed, so must I, poor worm, lie from morning till evening. My burning skin is worse off than the hot stove near me, which can, at least, as I feel, give off its heat. O, that I did know what I shall do! If I cry it brings the old woman with her milk, which increases my misery; if my hands are cold while my brain and skin are burning, she brings a few more wraps. I turn my half-closed eyes from side to side, seeking help, and my tormentor says "the baby shivers," and really heats the horrible things at the stove. Will no one come to my relief?

Tenth day.—Again a fearful night! I cry, but I am not understood. I must drink, drink, and again drink, until the stomach overflows. A half hour later they give me something with a horrible taste from a teaspoon. Air, air, pure, cool air, light, water! Shall I then have no help from this world?

Twelfth day.—Yesterday there was a great council of my aunts and cousins. Each one advised a different remedy for my sickness, but all agreed that its cause is a cold. Warmth was urgently recommended, and I received a new kind of infant food, just discovered, and some strengthening wine, which heated my brain yet a little more, so that I was deathly still. My body is wrapped so tightly with the roller that my stomach overflows every time a spoonful of anything is given. My feet are forcibly extended and enveloped so I cannot bring them up to relieve the pain, but my feeling is gradually going. Would that all were soon over.

Thirteenth day.—Farewell, thou beautiful world. Thy light and thine air have been denied me, but thither, where I go, there are no fetters.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.
Or from Messrs. W. H. Smith & Son, F. & E. Stoneham, and through any Newsagent.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page i. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

SOCIAL SCIENCE.

OUR MOODS.

Having reached a certain degree of superior emotional life, involving some of the character graces, such as generosity and gentle forbearance and pure aspiration, can we retain such a level? Nothing fixes itself more painfully on a strong man's mind than the fact that he is unable to be sure of his moods. There are many causes playing on us that make equability at our best impossible. This is true at least of all but an extremely limited few. These few we will consider before the close: but now we choose only to ask the question whether they are not hindered from a wide range of experience and whether they are not less capable of aiding others in trouble and temptation? But supposing all to be free of instability, and to need no aid—would that be a better state of society, namely, one in which there was little need of sympathy, and little sympathy: in which each one very easily took care of himself, and therefore altruism became superfluous? This, we can answer, is the ideal of social reformers who ask for a State in which there shall be absolute equilibrium. But we are confident that this is the best world, in which there is a deal of hard effort to be right, and in which there is nothing so good or great as the one who dies to help. It would be a sorry world that did not stand in need of the golden rule; it might be nearly as bad a one in which the golden rule was absolutely fulfilled.

The most human qualities of humanity are dependent on our protracted infancy. Because our helpless years are more than those of beasts, helpfulness has grown up and a wide degree of atruism. In other words, our protracted helplessness makes helping a great human virtue: and so comes about the beauty of a mother, and the courage of a father, and the sweetness of friendship. But from the same standpoint it may be argued with equal positiveness that a mental condition not quite in our own control, an unstable equilibrium of character, is productive of higher ranges and aspirations than one of absolute certainty. Of course, we do not wish to press this logic to extremes, only this we know, that when we have felt the east wind depressing us all day, and have been compelled to fight against a consequent irritability, we have learned a good deal, and have acquired a moral power that is real property if we have conquered. A good deal of this wrestling we call trying to overcome the devil: more of it we call the "Old Adam" in us compelling us to a sort of self-against-self contest. A later fashion only changes terms when it says we are troubled with our heredity.

This business of inheritance is one that is above all puzzling. When one thinks of it the wonder is that any one can have any individuality of his own. How many ancestors have something to say in us, and to do with our moods? If we are to go back to Adam, or the earliest anthropoid, which certainly seems to be a scientific necessity, it will not do to overlook the fact that all those between us and Adam also have a hand in us. This really starts a sort of a conflicting mixture in a man's brain, or soul, that is startling to try to imagine. But there probably is no necessity of such extended views; for the amount of influence that Jezebel now exercises in her descendants is pretty well comminuted. But it is a more serious matter when we count in our grandmothers and grandfathers of, say five or ten generations. That they really have a living influence in our emotions and propensities we thoroughly know. Our peculiarities are not our own. We find that a musical or mathematical genius is sure to have a cause in prenatal forces. But a curious and rather troublesome feature of this inheritance is that it is variable. At one period of life a man will "take after" one ancestor; at another period after another. Generally the special changes of life so shift conditions as to bring to the front a different inheritance. A very conservative youth is liable suddenly to tumble into a radical maturity; or it may be put the other way.

Does inheritance also affect our daily and hourly changes? This seems quite certain to one who is in the habit of studying himself. And never is it more clear than when he sets down his foot and resolves that, in spite of his ancestral biases, he will be himself. When most yourself please trace up the ancestral history, or open the portrait album, and you will be amused, if not vexed, to find that, after all, you are strong on the line. A better figure would be that you are a limb of the tree. But by wholesome and judicious marriages strong biases get to be modified, and you cannot tell how many permutations of character the family is capable of developing. In the same way you are yourself capable of a vast number of permutations. These constitute your moods.

Most quarrels come from not knowing that everybody must have times of ups and times of downs; and the commoner sort never get it in their heads that they are unstable. Generally a trifle of some sort will help a man of inferior grade to change his feelings, and go from moroseness to amiability. What shall we do about it? Shall we insist that every one else shall be sweet and bright invariably or be discarded? But, then, we all have the same trouble, and we think it hard that people cannot bear with us. Love me for my real self, you say; overlook the freaks and humours. But what is your real self? Are you sure that you know what your real self is, or that you love your real self, when it is known, instead of your humours? Most people admire most and are proudest of their whims. But really how are you going to get at the real one? Perhaps most of the moods are good ones, and there is a growing power to overcome the worse ones. If that be so, we may as well say that a man is made up of moods and as they are lovable—so he is lovable.

Are women more moody than men? So far as we may judge, we should say they are not. There is one peculiar quality of the feminine mind that is held in excess, we mean tenacity. It is useless to discuss a nervous corseted creature, who has never allowed herself to feel one free woman's emotion; but a real woman is something marvellous for persistence of sentiment. Nature, of course, plays some fine tunes on a woman's nerves that few men can find the key of, and as a consequence they, the men, lack the power to know exactly what nerves can touch of joy and glory. The highest need a man has of a woman is to teach him to be strong and valiant. Oh, no, we are not mistaken. The weaker sex is the male. Three males commit suicide to one female. More of us die of broken hearts. The hardest lots in the world are borne by women, and they rarely despair. The most terrible burden of life is child-bearing, which Nature assigned to woman. When we marry we do so to get comfort and encouragement. If we fail of that at home, we take to club life, or some other resort. A man can rarely endure alone. Women take life more easily, even when their lots are very low down and hard, and those who are well to do sun themselves as men never do. Let us see this matter as it is, and we shall the sooner be able to comprehend marriage. Because a man can bawl the loudest does not demonstrate that he is intellectually the strongest or best balanced to resist the antagonisms of life. Men shirk care more than women. They are incapable of

the minute home cares.

What, perhaps, is most to be dreaded about moods is, that we are unable at all times to see the world, or to interpret facts, without contradictions. It is an unpleasant habit that many literary people form of lying awake awhile in the night. There is, almost certainly at such times, a state of the brain that makes familiar matters take on hues very different from those they bear in the morning. For this reason most suicides, except of insane people, are in the night. What one can do with this logic it is hard to say. All we know is that at such hours we are more pessimistic. Something of the same kind occurs from indigestion, or from a ragged-edged storm, or from devitalising vices. There is a clear obligation on us to firmly hold ourselves in hand, and sturdily refuse to act on important questions until the sun shines and the air is smooth. It will not do for us to denounce our friends, or to make a revolution in our relations to the world, unless we have a sure conviction that covers more than one mood. Sleep over everything. This is the best salvation from most ills, to be firmly convinced that they are not ills. At least make sure that they are not humours.

We promised that, before closing, we would consider that happy few who live in a calm and little swerving mood of peacefulness. We envy such persons intensely, but we would not be one of the number if we could. To be sure we are striving to reach that condition, but do not think, having tasted the pleasures of struggle we should be satisfied with victory. Alexander wept for other worlds to conquer. That was the sublimest sight this world has ever seen. It is not possible to be satisfied with any good thing. Perhaps we are mistaken about these balmy people. Possibly there is an undercurrent of moods that they have power to conceal. If so they are not only to be envied, but to be copied. Our moods that fret and disturb the peace of others should not be encouraged. No one has a free right in the world to ventilate his whims and humours. Can we not at least suppress the worst?

Can we cultivate moods? There certainly are many habits which create moods which we can control. It is not impossible to make a keen self-study, which will end in such an understanding of ourselves that we shall be able to have some such directive power as we do over physical machinery. Why shall we be least of all able to control our own powers? The engine, run by steam or electricity, we study until we comprehend each screw and valve, and the working of it is an absolute science. Why shall a human being, who is an engine also, be least capable of guidance? Why so much wasted power? In our judgment man is the least studied of all forces and organisms. The era of metaphysics did nothing of this sort. It made vast assumptions, and ended by declaring man a divine failure. The era of physics is busy with other questions. We shall some time ere long return to study the human problem. In the future, perhaps not so very remote, it will not be the rule to let human beings go so largely to waste; but whoever is born will be held to be born for a wise purpose, and will be compelled to fulfil that purpose.

THE INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. 1, price 1s., post free, 1s. 2d.

Or through any Newsagent.

LADY-BIRDS.

Prof. C. V. Riley, at a recent meeting of the Washington Entomological Society, gave some notes on the life-habits of our common spotted ladybird (*Megilla maculata*). He gave descriptions of the egg and larva, which have hitherto never been described or figured, and also a *resumé* of the habits of the insect. The larva, he stated, was altogether entomophagous, as far as known, while the adults feed largely on vegetable material and also to some extent on soft-bodied insects, approaching more nearly in their food habits the genus Epilachna. He stated that the beetles are known to feed on the pollen of plants, to injure blades of corn, and also the soft kernels of corn, wheat blossoms, and the larvæ and pupæ of *Lina scripta*, the larvæ of *Diplosis tritici*, and other soft insects.

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

A Critical Correspondent.

H. Brewset.—We thank you for both suggestions and criticisms, notwithstanding that the latter appear to be somewhat far-fetched. As to your proposal that the names and addresses of successful competitors in the Science Queries and Answers department should be published, this does not commend itself to us. We used to publish the names and addresses of winners in the Prize Siftings Competition, and it was objected that too much space was occupied by these addresses, to the exclusion of matter more interesting to the general reader. You are mistaken in what you say as to the general practice in these matters, since we find high-class papers like *Pearson's Weekly* pursuing the same method as ourselves. There can be no reasonable ground for dissatisfaction among competitors, since we do not publish nor make any use of the rejected paragraphs.

We venture to think that the reply elicited by query 93 was one of great and general interest; and we dissent from your view that the answers selected demand a greater amount of scientific education on the part of the general reader than can be reasonably expected. Polysyllabic words are not objected to by us, nor by the majority of readers of scientific literature. Far from occupying more space, as you put it, such words serve to abbreviate sentences that would otherwise be drawn out to a tedious length. They give terseness, when the use of simpler words would necessitate great prolixity. Query 129 was certainly answered by the published paragraph. A rule was given by which the proportion of the earth's surface that can be seen at any time can always be calculated when the height of the observer is known. You are quite mistaken in supposing that *concentrated oxygen* cannot exist in association with concentrated nitrogen. As a matter of fact, at a depth of 15 miles, or even less, the atmospheric oxygen would be sufficiently condensed to be fatally poisonous, as stated in No. 33 of Science Siftings. As to the electric shock given to the bird, as narrated on p. 115, it was probably due to high potential electricity of atmospheric origin. The presence of such electricity in telegraph circuits is a well-known phenomenon of frequent occurrence. It is usual to provide special means for the prevention of injury to the telegraph instruments by such high potential discharges. We have ourselves seen the method you refer to, of inducing artificial respiration, successfully applied in the case of a small bird.

Miscellaneous.

Roland Whiting.—We appreciate your kindly and well-intentioned remarks. We would point out, however, that the retort which the journal in question drew from us was not without provocation. It is farthest from our intention to do anything calculated to injure the business of the photographer, whom we esteem highly. It is fairly obvious, however, that, by placing quite a nominal price upon the porcelain portraits, we are creating a demand which would otherwise not exist at all; in other words, we are supplying these porcelain portraits to persons who would not dream of paying anything like two guineas for them. Moreover, we would point out that, for every porcelain we supply for cash payment of 7/6, we supply fifty to friends sending in three annual subscriptions to Science Siftings.

A. R. Hinks.—The cause of the copper colour of the eclipsed moon was given in the answer to query No. 58, published in No. 22 of Science Siftings.

A Regular Subscriber.—The *Great Eastern* was 680 feet long, 83 feet broad, and 60 feet deep, being 28,627 tons burden, 18,195 gross, and 13,334 net register.

Silver.—The best battery for running the small electric lamps used by dentists is a two-solution bichromate. For prices and other particulars you may communicate with Messrs. Dollond & Co., of Ludgate Hill, E.C.

H. M. Schutz.—Your query was replied to in Science Siftings for May 28th last.

R. Wood.—Thanks for the correction. "more" should have been "less" in the 9th line of the reply to query 104. Your remarks in further explanation of the condensation of moisture by trees, lend additional interest to the subject. We will return to it when opportunity offers.

A. J. Cross.—The diaphragms of phonographs, telephones, etc. are made of thin tinned plate or ferrotype; such plate can easily b cut with scissors.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers.

PRIZES FOR THE WEEK ENDING JULY 2nd.

The senders of the first twelve letters, opened by us on Monday, July 4th, containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, the 4th instant, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 4th instant. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page ii. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors for the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

AWARDS.

The interest in this Scientific Puzzle is being fully maintained, 125 correct solutions having been sent in. The largest number of solutions received from one competitor was, however, only 32, the second ran close with 30. One competitor sends in the correct key to solving the Puzzle in a variety of ways, but sends in only 12 solutions. It is obvious from his figures that he might have sent in a very large number, but we are bound to adhere to the strict letter of our rules. The Prizes have been forwarded to the respective winners.

*** The Coupon will be found on page i.

Hope for the Bald

And all who suffer from

HAIR AND SCALP DISEASES.

Engraved from Photos., showing effect of "Eau Horn," age of patient 53 years.

Baldness in men, excessive falling off of the hair in woman, hald patches or premature greyness, cannot be cured with one and the same lotion. The disorders arise from quite opposite causes, and require specific treatment.

Do not waste money on so-called "Restorers," cantharides lotions, and nostrums for which impossible virtues are claimed by empirical pretenders. There is no such thing that will cure Baldness "from whatever cause arising," or produce "luxuriant growths in a few days." Advertisements to this effect are miserable frauds.

BALDNESS as seen in men (loss of hair from the crown or forehead) can be thoroughly cured by using my celebrated "Eau Horn." It removes the congested condition of the follicles (the cause of baldness) and provides food for the hair. Testimonials of cures (from eminent medical men included) with each bottle. Price per post, 5s. 6d. and 10s. 6d.

FALLING OFF and thinning of the hair, from which ladies suffer after illness and in the spring and autumn, is due to a feeble circulation and relaxation of the scalp. My "Germania Hair Tonic" used as a dressing will increase the absorbing power of the bulbs and re-establish the normal functions of the follicles. Post free, 3s. 9d. and 6s. 6d.

BALD PATCHES amongst the Hair or Beard (often resulting in total baldness) are due to a vegetable fungus, and require different treatment from ordinary loss of hair. My "Areata Lotion" will effect a radical cure even in chronic cases. Sufferers, do not despair! I have cured patients who have tried every nostrum in vain, and have exhausted medical skill. 3s. 9d. and 6s. 6d.

GREYNESS.—Grey Hair can now be restored to its own rich natural colour without trouble or danger to health. My celebrated "Acesma" supersedes all old-fashioned dyes and the dangerous so-called "Restorers." It is quick in effect, cleanly to use, odourless, permanent, and does not stain the skin. Medical certificate with each bottle. Price, 2s. 9d. and 5s.

SUPERFLUOUS HAIR, its roots and functions of reproduction destroyed with "Horn's Liquid Hair Solvent" (Regd. trade mark). Has no effect upon the skin whatever. No Plucking out required. This invention is indeed a boon to ladies afflicted with an unnatural growth of hair on the face, neck, or arms. Testimonials, press opinions, and medical certificates with each bottle. Post free, under cover, 2s. 9d., double size 4s. 9d., direct from

O. E. HORN,

HAIR SPECIALIST

(From the Berlin Skin Hospital)

NEWPORT, I.W.

London Agents:

Cassie & Co., 49, Newgate Street, E.C.

Personal Consultation by Appointment

ADVICE FREE OF CHARGE. Please Name this Paper.

Have You a KING'S POPULAR HAND CAMERA,

WITH FOCUSSING SCREEN? IF NOT, GET ONE AT ONCE.

PRICES FROM 10s. 6d. to £5 5s. PARTICULARS FREE.

E. A. KING, 133, Fulham Road, London, S.W.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6s. 6d. *6 months,* 3s. 4d., *3 months,* 1s. 9d

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisemt Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street, E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, JULY 9, 1892.

SCIENCE NEWS AND NOTES.

"Be assured that no good can come of your work but as it arises simply out of your own true natures and the necessities of the time around you."

—RUSKIN.

Our Invitation to Head Masters

to apply for volumes of SCIENCE SIFTINGS for their pupils, published in our last issue, has been freely taken advantage of, and as our offer is still open, we repeat the conditions. We will give a handsomely bound copy of Vol. I. of our paper to the head master of any school who may apply to us, in the ratio of one volume to each fifty pupils in the upper forms. The volumes are to be distributed as prizes among the middle and upper forms. No application coming from a head master will be refused, as our object is to encourage the study of scientific literature by the youth of Great Britain. We must ask the indulgence of those who have already applied, if there is any delay in the receipt of the volumes, as the applications have been more numerous than could be satisfied from our stock. We are, therefore, compelled to give a fresh order to our binders.

The Vitalising Energy of Sunlight

has received great prominence of late in the medical press. It is claimed that in those communities exposed to it the powers of endurance are from two to four times those of the average European. The argument is, therefore, that we should live in the open, sunny air as much as possible. This is all very well, but where is the poor, unfortunate worshipper of Mammon, who is at his devotions early and late, to obtain his daily sun bath? Not in this great city, for "Old Sol" has such a lofty contempt for the money grubbers that he absolutely denies his presence, save as far as the merest appetite-creating taste of it is concerned. However, the latest news in the electrical world is to the effect that man's ingenuity has created a substitute for sun rays, that will enable us to be absolutely independent of the luminary on whom, paradox as it is, the life of the world is absolutely dependent. Will the new discovery add a few million years, or perhaps an infinity of time, to the life of this sphere?

An Electric Light Bath

is the substitute for the sun bath, to which we have referred. It may be partaken of by anyone, with very little loss of time, who can afford the preliminary expenses of a suitable apparatus. This is a cabinet of the usual size of vapour baths with a lid inclosing the body completely, except the head, which is exposed. The lamps are distributed around the body of the bather, being arranged in groups of fourteen and operated by a separate switch for each group. About sixty lamps of 16 candle-power each of 110 volts are used in the bath. The sides of the interior of the cabinet are backed by polished nickel to give reflective power. A physician has made some tests of this bath, and has reported that the temperature of the patient in ten minutes rises to 148 degrees. After a bath the effect of the strong light is to brown the skin as if it had been exposed to the sun. The combined effects of the electric light and vapour bath in one are said to be without the usual depressing effects of the vapour bath alone. In fact, it has an opposite effect, making a patient buoyant and frisky. The switches and resistances are arranged to throw on section after section of light, or to throw off light as desired, each section, of course, adding to the light and heat of the bath. If the inventor could arrange such a bath for the head and arms of a patient, it might meet with a ready sale among those who cannot afford a summer trip, and who yet wish to present a sun-burned appearance in the autumn.

The Pasteur Treatment

has just undergone a remarkable development in France, which is of great interest to the medical faculty and the public generally. A man named Bossari, who had been admitted as a patient to the Pasteur Institute at Bologna after being bitten by a mad dog, began, on March 26th, to develop unmistakable symptoms of hydrophobia in a paralytic form and lost entire control of some of his most important functions. It became evident to the institute professors that the Pasteur treatment had been applied too late or had not acted on the nervous system with sufficient rapidity. It was then suggested that, as a last resource, the inoculations should be made direct into the patient's veins. The intervenous injections commenced on March 29th, and were continued until April 17th, when all symptoms of the hydrophobia had disappeared and the patient recovered. Eighteen of the injections were administered in oil. When the treatment began Bossari had lost the use of his legs, and had a diminution of nervous functions, which showed that the disease had commenced in the spinal cord, and that he was rapidly succumbing to its influences. The injection of the Pasteur lymph into his veins arrested the course of the disease and resulted in recovery.

The Advantages of Fogs

have evoked an expression of approval from no less an authority than the president of the Institute of Civil Engineers. He declares that the sulphurous vapour produced during the combustion of coal is most beneficial to the health of the inhabitants of London, disagreeable though it undoubtedly is. As many as 350 tons of sulphur are thrown into the air in one winter's day, and the enormous quantity of sulphurous acid generated from it deodorises and disin-

fects the air, destroying disagreeable smells emanating from refuse heaps and sewers, and killing the disease germs which find their way into the atmosphere. There may be a good deal of truth in this view, but there is undoubtedly another side to the question. It is an old comparison that a doctor and his drugs bear a relationship to the patient and the disease like that of a policeman towards a householder attacked by a garotter. The policeman lays about with his truncheon, sometimes he hits the householder, sometimes the garotter, and the good or ill which results from his interference will depend upon which party happens to get the most and the heaviest blows. This simile is admirably suited to sulphurous acid in London fogs, for although it may be beneficial to the London householders by destroying microbes, it certainly frequently does them harm by attacking their lungs and bringing on bronchitis and asthma which sometimes prove rapidly fatal, to say nothing of the minor discomforts of a disagreeable taste, filthy smell, stuffed nose, husky throat, smarting eyes, and headache. The *Lancet* is of opinion that, healthy though the London fogs may be, the discomforts they cause are so great that Londoners would be really better without them, and that less disagreeable and equally efficient means might be found to clear the air of microbes, while at the same time these other remedies would be enormously cheaper, for they would not entail the almost complete stoppage of traffic or the enormous expenditure of gas and electric light which a bad fog occasions.

Man Still Uses Milk

much as his primitive ancestors used it; namely, in the raw or uncooked condition. And yet the milk of a modern city is altogether different from the milk consumed by primitive man. It is seldom fresh; it is often adulterated, and it is usually dirty. The stable, and travel more or less prolonged, have had their effect, so that the milk when delivered is often far along on its way toward decomposition. It is well to remember that milk is an animal secretion prepared in much the same way as are the tears, the bile, the gastric juice, the urine, the sweat, and the saliva. It is secreted in the mammary gland, or udder, by certain epithelial cells which manufacture it from the blood. During the process of secretion these cells break open and contribute of their substance to the mixture of water, salts, sugar, and fat, which constitute milk. At every milking a portion of the udder substance, the actual animal stuff, is given off; and thus it comes to pass that milk is strictly an animal food, like an infusion of muscle or of liver. It is unnecessary to say more to make it plain that it is highly unstable, highly decomposable, highly putrescible.

The Fluid is Swarming with Bacteria

before it finds its way to large cities. Most of these are probably harmless vegetables; nevertheless they constitute a host of organisms entirely foreign to the milk itself. The so-called "pure" milk ordinarily obtained in cities, even when it has not been tampered with, frequently contains in a teaspoonful millions of these microscopic vegetables, luxuriantly thriving in a soil most favourable for their development. Moreover, although themselves invisible, they do not fail to produce obvious effects. The souring and chemical decomposition of the milk, which soon appear, are due exclusively to their vital activity, and the milk which was originally sweet, and which in their absence remains for ever sweet, becomes, owing to their activity, sour and chemically decomposed. In this condition it has important uses, but it is no longer "fresh" or "sweet" or "normal" milk. Under the worst conditions milk may actually be delivered to the consumer nearly or quite sour. That milk must be regarded as normal which is drawn from the teat of a healthy cow. In such normal, or udder milk, we have found no trace whatever of bacteria.

Two Principal Sources of Bacteria

are to be found in milk, namely, contamination during the act of milking, and the natural multiplication of the bacteria thus introduced during the interval between milking and the consumption of the milk. The result of our investigations is to show that even under the most favourable conditions, cow's milk as ordinarily drawn becomes, almost necessarily, infested with hosts of putrefactive bacteria at the very outset. Under worse conditions, with unclean stables and dirty milkmen, to say nothing of half-cleaned pails and cans, it is easy to understand why milk swarms with bacteria; and if we allow time also, the wonder is, not that it contains so many germs, but rather that it is still potable at all. When we reflect upon the indescribably filthy condition of many cow stables; upon the fact that the cow's udders and flanks are not infrequently covered with flaking excrement; upon the quality of the men employed to do the milking, etc., etc., it becomes a simple matter to understand how this rich animal fluid—sterile at the start, but drawn by unclean hands into half-cleaned pails, and meantime sprinkled from above by the dust of the stable, by hairs, dandruff, dirt, and particles of excrement from the skin and udder of the cow vigorously shaken by the milker or brushed by his hat—becomes infested with organisms. That these multiply swiftly and enormously in the warm and rich fluid, well aërated by the act of milking, is also a natural consequence of favourable conditions. We commend the conditions to which milk is subjected from the time of leaving the animal to the period when it finds its way into consumption, to the parental consideration of the brand new Parliamentary powers that soon will be.

One Word More

to the consumer of milk. Even if the producer does all that is required of him in a hygienic way, there still remains a little advice to be given as to the proper method of drinking the fluid. Do not swallow milk fast and in big gulps. Sip it slowly. Take four minutes at least to finish a glassful, and do not take more than a good spoonful at one sip. When milk goes into your stomach it is instantly curdled. If you drink a large quantity at once it is curdled into one big mass, on the outside of which only the juices of the stomach can work. If you drink it in little sips, each little sip is curdled up by itself, and the whole glassful finally finds itself in a loose lump made up of little lumps, through, around, and among which the stomach's juices may percolate and dissolve the whole speedily and simultaneously. Many people who like milk and know its value as a strength-giver think they cannot use it because it gives them indigestion. Most of them could use it freely if they would only drink it in the way we have described, or if they would, better still, drink it hot. Hot milk seems to lose a good deal of its density, and one would almost think it had been watered, and it also seems to loose much of its sweetness, which is cloying to some appetites.

Bacteria are not Wholly Bad.

It is true that they are the causes of evil, that they produce disease; but it is also true that they do good. They are our enemies, but they are also our closest allies. It is true that without them we could not have our smallp ox 1.0

our yellow fever, we could not have our diphtheria nor our scarlet fever, neither should we have any of the epidemics. But when we remember that it is through the agency of these organisations that we bake the loaf of bread that comes to our table; that the immense brewing industries connected with the manufacture of alcoholic liquors are possible; that without them we could not get our vinegar or our lactic acid; that without them we could not make our ensilage; that these bacteria give the butter-maker the aroma of his butter; that it is the decomposition products of the bacteria that the cheese manufacturer sells in the market; when we remember their agency as scavengers, how it is that they keep the surface of the earth clean and in a constant condition for the growth of plants; their value to the soil in decomposing the dead bodies of animals and plants, and thus enabling the same material to be used over and over again for the support of life; and lastly, that it is only through their agency that plants were originally enabled to get hold of nitrogen at all, and that we may hope for a continuance of a supply of nitrogen to the soil—we will recognise that the power of bacteria for good far outweighs their power for evil.

The History of the Tile Fish

is among the strangest known. So far as we have any information, no one, fisherman or naturalist, ever saw a tile fish (the common name is an abbreviation of the generic *Lopholatilus chamæleonticeps*) until March, 1879, when a Gloucester (U.S.A.) fishing schooner took about 6,000 pounds. In the following years, 1880 and 1881, a few were taken by the U.S. Fish Commission steamer. In March and April, 1882, vessels arriving in American ports reported passing through large numbers of dead and dying fish off the southern coast of New England and Long Island. Vessels reported sailing from forty to sixty miles through floating fish (in one instance through 150 miles), so that it became evident that a vast destruction had taken place. Captain Collins estimates from these reports that an area of 5,000 to 7,000 square statute miles were so thickly covered that the total numbers must have exceeded a billion. The next year the Fish Commission searched in vain for these fish on the ground where they were formerly so abundant, and no one has since reported a specimen.

In Speaking of Cleopatra and the Pearls,

our esteemed contemporary, *The Diamond* (Allahabad), is, for once, guilty of a little slip. "No acid," says *The Diamond*, "that would dissolve a pearl, which is nothing but carbonate of lime, could be swallowed by any human being with impunity." Had the editor been as good a chemist as he is a jeweller, it would not have been implied that dissolved pearls may not be swallowed without any injurious effects. Take even the strongest muriatic acid. Pearls would be almost instantly dissolved in this acid, and the resulting solution, chloride of calcium—would be perfectly harmless. Chloride of calcium is even recommended by some medical authorities as a remedy for nausea and for dyspepsia. Whether chloride of calcium was the solution drank by Cleopatra, and to which the editor of the *Diamond* more particularly refers, is, of course, another question. The earliest reference to the use of muriatic acid, that we can call to mind specifically at this moment, is to be found in one of Basil Valentine's works, published in the fifteenth century. Valentine describes this acid as "spiritus salis," prepared from "guten vitriol," and "sal communi." But we believe that muriatic acid was also known to the Arabian alchemists.

Detective Microphones

are about to be introduced in some of the Russian prisons So we are informed by a Berlin correspondent, who tells us that an electrical firm in that city has received an order from St. Petersburg for a number of sensitive microphones. These instruments are to be fitted in an artificial brick, made of hard wood, and having one side sufficiently thin and flexible to take up and transmit aerial sound waves. One of the eavesdropping bricks is to be built into the wall of each cell where political prisoners are confined, and the hidden microphone is to be electrically connected to a telephone in the Governor's room. A regular telephonic exchange will be called for, we should suppose, in some of the large Russian dungeons. It is to be regretted that none of the unfortunate wretches on whom this trick is to be played are to be counted among the readers of SCIENCE SIFTINGS. Nevertheless, as we have nearly a hundred regular subscribers resident in the Russian empire, perhaps the post office detectives will object to this paragraph there and confiscate our mail. We shall see.

An Enormous Aerolite,

believed to be the largest that has ever fallen, is now lying in the Caspian Sea, a short distance from the peninsula of Apsheron. The aerolite made a terrific noise as it rushed through the air, and the white-hot mass made a light that illuminated the country and sea round about for a great distance. When it struck the water immense clouds of steam arose, and the hissing could be heard for a great distance. Huge masses of water were thrown upward, and the sight to those who were not frightened was an exceedingly beautiful one. So enormous is the aerolite that it projects twelve feet above the water, and, save for its fused black crust, which gives it the appearance of having been varnished, it has every appearance of being one of the usual rock formations met with along the coast. Scientists are deeply interested in the phenomenon, and several of them are making preparations to visit the peninsula to examine the aerolite. Further information is needed before credence can be given to the above, which comes in a despatch from St. Petersburg.

The Planet Mars,

writes Mr. G. Knight, will arrive on August 5th of this year at an angle exactly opposite the earth, when the distance will be only 37,000,000 miles. The real distance of Mars being 141,000,000 miles, this will afford all those interested in astronomy an ample opportunity of proving M. Flammarion's theory—who seems to think that the planet is talking to us. He says that in the newly-constructed maps of Mars there are observable in several places small dots, by the side of which the astronomer notes the presence of luminous spots that shine like snow under the rays of the sun. It is not probable that these spots are due to the presence of snow, since some are situated near the equator, while others are in high latitudes. Nor can they be mountain peaks, for they are close to the seas and symmetrically disposed with reference to certain rectilinear canals. Furthermore, several among them appear to mark parallels of latitude and meridians, and in examining them one is inevitably reminded of geodetical signs. The close observer can distinctly trace triangles, squares, and rectangles formed by these luminous spots. If methodical changes be discovered in the course of a few years, or even centuries, it will be hard to resist the conclusion that the guess of the Parisian writer is correct, and then will begin the effort to reciprocate. Evidently this will be much the worse job of the two on account of our relative position.

GLEANINGS OF THE GLOBE.

THE temperature of the well at Wheeling, W. Va., which was 79° at a depth of 2300 feet, is said to have increased to 108° at 4300 feet and 111° at 5400 feet.

THE Portsmouth Sanitary Institute will hold a health exhibition, to include scientific exhibits connected with hygiene, from September 12th to October 8th.

TWO Swedish astronomers, Lemstrom and Trumholt, are reported to have produced artificial auroras by means of a network of electric currents between two mountains.

A RAY of light which would travel around the earth in about one-eighth of a second, takes more than four hours to come from Neptune. From Alpha Centauri, the nearest fixed star, light makes the journey in five and one-half years.

WE have received a copy of No. 1 of the *Humanitarian*. It is an Anglo-American monthly publication, but of universal sociological interest. The editor is Mrs. Victoria Woodhull Martin, and communications may be addressed to 17, Hyde Park Gate, London.

CYCLONES originate in the tropics, and are chiefly found in five localities: The West Indies, Bengal Bay and the Chinese Coast, north of the equator, and in the South Indian Ocean off Madagascar, and the South Pacific near Samoa. In the Antilles there are not half a dozen, on the average, every season.

PYTHAGORAS thought the heavenly bodies to be separated by intervals corresponding to the harmonic lengths of strings, wherefore he and his followers held that the movement of the spheres gave rise to a pleasing sound called the harmony of the spheres. He taught this, and also that the first sounds perceived by the human ear were the music of the spheres.

DURING one day the human body generates enough heat to melt 40 lbs of ice, and raise it to the boiling point. A visionary is engaged in inventing an apparatus whereby the surplus of this heat may be stored up and used for cooking one's dinner. The apparatus will be exhibited at the World's Fair, in 1893, alongside the rain-making machine, Keely's motor, and the air ship.

AN electrical instrument has been recently invented for avoiding the pain incident to the extraction of teeth. It is described as consisting of adjustable prongs, carrying buttons and connected with an electrical battery. The buttons are placed on the face over the nerves leading from the teeth to the brain, and a circuit is established the moment the extracting instrument touches the tooth.

APES may be easily distinguished from monkeys by the unscientific by their having no tails. Their skeletons show them to be, in this respect, like man. The monkeys usually have long tails, while the baboons have short tails. These are not the only marks by which they are known; but these answer in a popular way as a ready index to distinguish apes, monkeys, and baboons.

THE latest invention for the saving of life at fires is the "emergency dress." It is a woman's idea. It consists of a dress something like that used by submarine divers, but much more simple, and made from asbestos cloth.

THE latest news of Edison is to the effect that he is now seen quite frequently in Wall-street—the Throgmorton-street of New York. His hair is greyer than it used to be, and it is said that he realises that he must not work so hard as he has in the past. More of his evenings are spent at his charming home in Orange than formerly, when he almost lived in his laboratory.

A SCIENTIST has made a calculation about the time it will take to fill the world with all the people it will hold. The present population of the globe he supposes to be about 1,467,000,000; and he estimates that the maximum of the inhabitants that can be sustained on the entire land surface of the earth is 5,994,000,000, and that this figure will be reached A.D. 2072, or in about 180 years, at the present ratio of increase, which is 8 per cent per decade.

WRITING from Plymouth, "Parabola" says that if SCIENCE SIFTINGS would offer a premium of £1,000 to the man who should prove that the earth does not rotate, he "would mention certain facts," etc. We think that "Parabola" is a very mercenary scientist; however, we have much pleasure in acceding to his request. "Parabola" may send on his facts, or rather his speculations, and if they include anything of general interest, we will publish them in SCIENCE SIFTINGS.

A FRENCHMAN has patented an apparatus by which a driver of a vehicle can release a carriage from runaway horses. The action takes place in the traces. By a simple mechanism, the driver, by pulling a strap, works a spring buckle fixed at the end of the traces, they immediately fall to the ground, and then the horses release the straps fixing the pole to their collars, the straps being provided with similar spring buckles, which are opened as the horses press forward.

A PROSPECTOR in Montana (U. S. A.) has found a strange mineral that takes fire and consumes itself when exposed to the air. When taken from the ground it has much the appearance of iron ore, and is quite as heavy. The first that was taken out was piled up near the shaft one evening, and the next morning was found to be smoking. It continued to grow hotter until it arrived at almost a white heat, remained in that condition for several days, after which it gradually cooled off. It was then found to be but half its first weight, and resembled much the fragments of meteors that are found on the surface.

HERE is an easy method of determining whether a supposed diamond is genuine or not:—Pierce a hole in a card with a needle and then look at the hole through the stone. If false you will see two holes, but if you have a real diamond, only a single hole will appear. You may also make the test in another way. Put your finger behind the stone and look at it through the diamond as through a magnifying glass. If the stone is genuine you will be unable to distinguish the grain of the skin, but with a false stone this will be plainly visible. Furthermore, looking through a real diamond, the setting is never visible, whereas it is with a false stone.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 36.

139.—What is space of four dimensions?

No distinct conception of space having a fourth dimension can be formed in the mind's eye. Our ideas of such space depend solely on the assumption that there may be some necessary untrueness, that has not yet been discovered, in Euclid's geometry. Some idea of the nature, although not of the cause of the peculiarities of such four dimensioned space, may be got by the aid of an analogy imagined by Sylvester, He supposed reasoning beings having only two dimensions, *i.e.*, length and breadth, to live on a flat surface having no thickness—such a surface as Euclid describes as plane. These infinitely thin people would establish a system of plane geometry identical with ours. But we must suppose that any curvature may be given to the infinitely thin surface on which these beings live. The surface may, for instance, be that of a sphere, and if of one sufficiently large in comparison with the two dimensions of the reasoning, beings it may be undistinguishable by them from a surface of no curvature. In this particular case motion of the hypothetical beings through their curved space would not be manifested to them by any alteration in their "laws of nature." And, if the measure of curvature were small enough, geometrical experiments capable of demonstrating it, by disproving the axiom of parallels, and showing that the three angles of a triangle are not necessarily equal to two right angles, might as has already been intimated, be found difficult or impossible. Turning now to our own case as three dimensioned beings, the greatest geometrical sounding lines that we can throw out into surrounding space are triangles, of which the base is the diameter of the earth's orbit, and the vertex may be any fixed star. In these the geometry of Euclid seems to hold good. But within the limits of accuracy as yet attained in astronomical measurements, there may be a discoverable indication of curvature, that may be considered, although the term is scarcely appropriate, as involving a "fourth dimension." Since the universe is a mere point in infinite space, we must not conclude that because the measure of curvature is apparently small where we now are, the probabilities are, therefore, against the existence of such curvature.

140.—How should water be purified for drinking purposes?

Water can be purified by freezing it; still better by distillation, but the pure water thus obtained is deærated and insipid. It should be very slowly filtered through charcoal with access of air. The result is that owing to the peculiar property possessed by charcoal of condensing gases in its pores the oxygen of the air, in a concentrated form, is brought in contact with every minute particle of water. Thus any organic matter that may be present is oxidised and rendered harmless. Since it is only the presence of organic matter that must be guarded against in ordinary drinking waters, there are several ready methods by which these can be purified by the simple addition of a soluble oxydising agent. Permanganate of potash is such an agent, and, in minute quantities, it exerts no ill effects upon the human system. It can, therefore, be used with advantage. The process is to add just enough of the permanganate to impart a permanent pink tinge to the water. When this has been done, it will be found that all the organic matter present has been precipitated as a brown sediment. The writer makes a practice of carrying a small homœopathic medicine bottle filled with crystals of permanganate, and of treating all suspected drinking water in the way described.

141.—How are the metals dissolved in a liquid recognised by chemical analyses?

The metallic solution of unknown constitution is treated with what are called "group reagents" in a certain order. Each group reagent may produce a precipitate from the solution, and in this precipitate one or more metals belonging to a single group only will be found. As an example, the metals of the first group (silver, mercury, and lead) are precipitated by the addition of hydrochloric acid. The white precipitate is collected on a filter, and the liquid filtrate is then admixed with the reagent for the second group of metals, and so on. Each of the solid precipitates must now be examined separately for the recognition of such metals belonging to their respective groups as may be present. I take for the simplest example the case of the white precipitate thrown down, as aforesaid, by hydrochloric acid. Boiling water is poured on to the filter in which are the precipitated chlorides of the mixed metals. The boiling water extracts all lead chloride that may be present, and the existence of such lead salt in the filtrate can be readily proved (by the addition to it of sulphuric acid, which causes a white precipitate of lead sulphate). Silver chloride, if any be present on the filter, is not dissolved by the hot water, but is extracted by treatment with ammonia, and can be tested for in the filtrate. The presence of mercury is shown by the precipitate on the filter turning black immediately on the addition of the ammoniacal solution.

142.—How is the value of fuel determined?

Fuels cannot be said to possess any absolute value, except in relation to such conditions of combustion as may in particular cases be practically attainable. Apart from this, what is called the maximum calorific power of a combustible may be estimated by burning it in a closed calorimeter (surrounded by water) and deducing the amount of heat evolved by the rise in temperature of the instrument. Of still less practical importance is the ultimate chemical analysis of the fuel, performed by raising it to incandescence, together with oxide of copper, in a closed tube, and then analysing the gases into which, under these circumstances, combustible matter is wholly resolved. The bulkiness of the fuel is important from the commercial point of view; and this is given, of course, by the measurement of specific gravity. What is called proximate analysis is useful as giving (1) the percentage of volatile matter, by igniting a weighed quantity (say 10 grammes) of the fuel in a platinum crucible, in absence of air. (2) The percentage of ash by similarly igniting the fuel, with access of air; and (3) the percentage of sulphur, by a process of wet analysis. Sulphur is naturally objected to, on account of the unhealthy and destructive effects that its combustion

produces. Besides, sulphur is liable to spontaneous combustion.

143.—Where does the greatest quantity of rain fall ?

In the Khasi Hills, Cherrapunji, India, where more than 490 inches of rain fall, on the average, every year. As much as 150 inches of rain has fallen in five days upon the Khasi Hills ; that is to say, 348,480,000 cubic feet per square mile.

144.—Are chronometers or pendulum timepieces most accurate ?

Pendulum timepieces are the most accurate, because it is practically impossible to maintain a uniform temperature in the clock case ; and the variations in length of a pendulum can be more accurately compensated than those of the elasticity of a spring. Besides, the pivot of a balance wheel, owing to the variable viscosity of oil, introduces a varying resistance that is wholly absent in pendulum clocks.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest ; and those selected will be published in the issue after next.

151.—What are the physical characteristics and market prices of the metals more costly than gold ?
152.—Why are rain-drops globular ?
153.—What description of compass is now employed in high-class sea-going vessels ?
154.—On what grounds is it asserted that the sun is not fixed in space ?
155.—How is ice made by machinery ?
156.—What is the cause of long and short sight, and how may it be remedied ?

HOW MUCH ELECTRICITY WILL KILL.

Notwithstanding the amount of matter published regarding the resistance of the human body and the current which will kill, the subject seems still to be greatly misunderstood by many, partly because numerous persons interested are not sufficiently well posted in electrical matters to understand the statements made, and partly because such statements often appear contradictory, making the whole subject look mysterious. There are, for instance, about as many different figures given for the resistance of the human body as there are authorities for such statements. Furthermore, the question is often asked, "How many volts will kill ?" It is stated by some that 30 or 40 volts will kill a horse, while others ask why it is that Tesla is not killed when he takes many thousand volts if 3,000 volts have been known to kill in a number of cases.

The writer himself, on the top of one of the Alpine peaks in a storm, has had lightning pass through his body to an extent sufficient to make a loud crackling noise and to produce long blue streams of sparks from the fingers, representing probably many millions of volts, without any effect on the body other than to induce him to descend without delay. Others report having taken "the full current of a 1,000 volt alternating current machine through their body" without fatal effects, while in still other cases flesh has been burned to the bone without proving fatal. These apparently contradictory statements make it seem to many that little is known about this subject. This is not the case, however. Although there is room for more definite knowledge, a good deal is known ; it requires only to be properly stated. It reminds one of the old story of the colour of the chameleon ; all three of the observers were right in their observations but wrong in their conclusions.

Regarding the resistance of the body it is well known that this resides chiefly in the skin. If the skin is very dry and thick, as on some workmen's hands, it is almost an insulator ; while if it is moistened with perspiration, with water, or better yet with caustic potash, which penetrates the pores as it dissolves the fatty substances, the resistance of the skin becomes very low. The condition of the skin and the size of the electrode in contact with it are therefore probably the most important factors in measuring the resistance of the body. If the electrodes were placed in incisions made through the skin the resistance would doubtless be exceedingly low. A horse is easily shocked through the shoes because the nails penetrate into the moist parts of the hoof, thus making a good contact through the insulating horny substance ; besides this, his hoofs are often wet with mud. The current necessary to kill depends very much on the nature of the contact with the moist parts of the body, and it therefore cannot be said that a certain number of volts will or will not kill. Furthermore, the quantity of the current in amperes actually traversing the body is also an important factor.

In Tesla's machine the quantity of current is small and insufficient, as the body is capable of taking care of it rapidly enough to prevent danger. The source of the current must therefore be great enough to develop a sufficient quantity of current as distinguished from the voltage alone. In all electric light and power circuits there is always sufficient quantity. It would appear from this that the number of amperes might be a better gauge than the number of volts, but the time is also of importance, as the same current is no doubt more dangerous if it continues to pass for a longer time. One author states that one-tenth of an ampère for one second is sufficient to kill. This, though more rational than merely the number of volts, is still not sufficiently definite, as in many cases a great enough number of amperes has been taken locally to burn and char the flesh without producing death. It appears, therefore, that a current, to cause death, must pass *across* the body ; that is, through some vital part, and not merely through part of an arm or a leg.

A comparatively large current passing in at the hand and out of the shoulder would not necessarily cause death directly, but if it passes through to the other hand, thereby passing through the heart, it would doubtless prove fatal. To summarise, it is therefore not rational to speak in general of the definite resistance *per se* of the human body, nor to say that more than a definite number of volts is fatal, except between very wide limits. The nature of the contacts must first be considered, then the number of amperes, and the duration, and finally the question of the current through the body in relation to the vital parts. The voltage must then be great enough to send that current through that particular resistance of the body, according to Ohm's law, and the source must generate a sufficient quantity of electricity to keep this current flowing. Finally, there appears to be also a counter electromotive force in the body, which must be considered, and there is besides doubtless a difference between the effects of alternating and direct currents. A direct current probably decomposes the tissues by electrolysis and a high potential discharge may act in the form of rupture of the tissues.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

A THEORY OF THOUGHT TRANSFERENCE.

"Assume, as I have done in the first part of this article, that the cerebral radiations partake of the nature of thermal, luminous, electric, or magnetic, radiations, and the following explanation of telepathy, or thought transference, is, to say the least, not improbable.

"I would explain the possibility of the transference of specific cerebral vibrations from an active brain to a passive or receptive brain, by the simple action of what is known in science as sympathetic vibrations.

"Take the case, for example, of a vibrating tuning-fork that is sending off its waves across the space which separates it from a second tuning-fork, not as yet in motion, but tuned so as to be able to vibrate in exact unison with it. As is well known, the exact correspondence between the period of the active or the transmitting fork, and the passive or the receptive fork, is such that the vibrations of one fork are gradually taken up by the other fork, so that the energy of the motion of the one is transferred or carried across the space existing between them by means of pulses or waves set up in the air which surround them.

"As is well known, such sympathetically excited vibrations can be produced in a fork situated at a considerable distance from the exciting fork.

"Or, similarly, take the case of the sympathetic vibrations excited by waves of light. Solar energy is radiated or transferred across the space existing between the sun and the earth by waves or oscillations in the luminiferous ether. These waves, falling on the delicate structure of a leaf, suffer a species of selective absorption, certain wave-lengths being absorbed and others thrown off. The absorbed waves excite or produce sympathetic vibrations in the molecules of carbon dioxide present in the leaf, and cause the atoms of carbon and oxygen in such molecules to move towards and from one another in interatomic vibrations, which increase in amplitude or violence until their chemical affinity or atomic attraction is overcome and dissociation occurs. The oxygen is then thrown from the leaf into the air, and the carbon is retained in the structure of the plant.

"Or, take the still more interesting case of what Hertz calls electric resonance. As already mentioned, it is now generally recognised by electricians that a conductor, which is the seat of an oscillatory electric discharge, is sending into the space around it electric waves or oscillations which travel with the velocity of light, and which are, in fact, of exactly the same nature as light itself. If these electric waves meet a circuit so tuned as regards the period of oscillation of the circuit in which they originally occurred as to be in consonance with them, electric oscillations will be set up in this circuit of exactly the same nature as those exciting it.

"In view of these facts, it does not seem improbable to me that a brain engaged in intense thought should act as a centre of cerebral radiations, nor that these radiations proceeding outwards in all directions from such brain should affect other brains on which they fall, provided, of course, that such brains are tuned to vibrate in unison with them. In such cases the absorption of energy by the recipient brain may be either a species of selective absorption, in which its train of thought is only modified, or it may be absolute, in which case the recipient brain has excited in it an exact reproduction of the thoughts of the exciting brain.

"Such a hypothesis is far from improbable; on the contrary, it would appear to be carried out by a variety of curious circumstances, which have only wanted some general hypothesis to properly correlate them.

"If such a hypothesis be true, then these cerebral vibrations or radiations must travel through space with exactly the same velocity of light. This is, of course, on the assumption that the vibrating or oscillating brain molecules or atoms set up vibration similar to those of light. Of course, this equality between the velocity of cerebral wave propagation and that of light is true only for free ether. In the ether which fills the interatomic or intermolecular spaces of gross matter, or, as it is technically called, combined ether, the velocity of wave propagation varies according to the particular character of the matter with which it is associated. A retardation or decrease in the velocity of the assumed cerebral waves would doubtless be experienced while passing through the materials of the skull and head.

"If thought travels along waves in the ether similar to waves of light, it would be able to travel along any path by which rays of light can pass. It can, therefore, travel along rays of light, *i.e.*, along paths in the ether through which rays of light are moving.

"There is a well-known experiment in hypnotism, in which the patient, placed in a state of semi or complete unconsciousness, has his brain called into a more or less active condition by the suggestions of the hypnotiser, which might seem to somewhat favour the hypothesis of cerebral radiation.

"It might be interesting, in view of the above suggestions, to see whether a hypnotiser, placed in such a position as regards the hypnotised that flashes of light falling on his eyes shall afterwards fall on the eyes of the patient, to observe whether or not acts of suggestion are more readily perceived by the brain of the hypnotised along such rays of light than without the aid of such rays.

"If the preceding speculations be regarded as wild—and that this is true I have already granted—what may not be said as to the following?

"If thought radiations partake of the nature of ether waves, then there should presumably exist in the thought radiations or waves, phenomena corresponding to the various phenomena of thermal, luminous, electric, or magnetic radiation; even the phenomena of reflection, refraction, and possibly even of dispersion of such waves, would appear to be a possibility. In this connection, it is of interest to imagine the analysis or separation of a complex wave of thought into its component or elementary waves, corresponding to the separation of a beam of light, by means of a prism.

"In this connection there would be a new significance in the phrases 'radiant with thought, or to concentrate one's thoughts on a subject.'

"If thought radiations or waves partake of the nature of light, then it would seem among the remote possibilities of science, to obtain, say by means of a lens, a photographic impression of such thought waves on a suitably sensitised plate, somewhat after the manner of the ordinary photographic picture. Such a thought record, suitably employed, might be able to awaken at any subsequent time in the brain of a person submitting himself to its influences, thoughts identical to those recorded.

"Of course, I am aware of the improbability of such a record being obtained in the near future, and of the exceeding difficulties that would seem to stand in the way of ever obtaining it.

"Until we know something more definite concerning the nature of these assumed cerebral vibrations and of their lengths, we must necessarily be seriously handicapped as to how best permanently to fix them on a suitable record surface, and how afterwards to cause such record surface to

interpret its peculiarities to the brain. I merely throw it out as a possibility of what science may have in store for those who come after us. I would suggest, in this connection, that one hundred years ago it would probably have been regarded as quite impossible that the telephone or the phonograph could have been produced.

"Such a thought record, however, if obtained, would not be an image of the thought itself, or of the particular groupings of the articles, whose to and fro movements attend or produce thought, any more than the tracings of the phonograph record form an image of the spoken words. They would merely represent to and fro motions of the ether set in motion by the thought or cerebrations.

"An eye looking at such an image would not be influenced thereby. If, however, ether waves similar to those recorded could be produced by causing light to pass through such photographic images of the to and fro motions of thought waves, such waves might be caused to influence the brain and thereby awaken thoughts similar or identical to those recorded.

"I have often amused myself with picturing a possible thought-recording machine, whereby the thoughts of an active brain might be continuously and permanently recorded on a moving sensitised film, the exposed surface of which was placed at the focus of a large lens placed in front of any one engaged in intense thought.

"If, like the cylinder or plate of a phonograph or gramophone, such a record were afterward rotated at the same speed as that at which it received its impressions, under circumstances in which light passing through it is moulded into waves similar to those recorded on it, such waves when caused to act on a receptive brain, should, it would certainly seem, excite therein thoughts identical to those recorded as its record surface.

"Of course, it is needless for me to say that such a machine has never been actually constructed, and is still as substantial as are the speculations which I have offered you. Indeed, the probabilities against its being produced are so great that I have hesitated even to mention it.

"Some experiments might be tried in a similar manner in thought transference, by holding large lenses in front of the eyes of a hypnotiser at such a distance as to converge the assumed cerebral radiations on the eyes of the hypnotised. These experiments might be tried either along with light or independent of it.

"I know that many points of the hypothesis which I have suggested are quite improbable, and that I may and probably will be misunderstood by some as putting forward facts rather than a bare hypothesis.

"Probably one of the most serious objections to the hypothesis is to be found in the fact that the phenomena of telepathy and thought transference are not of more frequent occurrence. This I must frankly acknowledge to be a most serious objection. I would suggest, however, that the comparative infrequency of the phenomena may possibly be explained by the presence in the human body of a shield which protects the brain or the nerve centres from the effects of cerebral radiations. It is not impossible the sheathes of the nerves act as screens to prevent the reception by the brain of these thought radiations.

"Prof. Tyndall, in his work on sound, alludes to the well-known fact that when sympathetic vibrations are being excited by a sounding tuning-fork in any body near it, that there is a greater expenditure of energy of the fork's motion than when it was not exciting such waves. The analogue of this phenomena exists, perhaps, in the case of the assumed thought transference. Mental energy is presumably expended at a greater rate when it is exciting thought waves in this manner than when such are not being excited.

"There has often been experienced by me as a teacher a feeling of great exhaustion in taking charge of or watching a room in which a number of bright students were undergoing an examination. It is possible that the cause of this exhaustion is the rapid dissipation of energy by the cerebral radiations being absorbed by the receptive brains of the examinees. I am informed by certain physicians that a feeling of great exhaustion is experienced by them in the treatment of some cases.

"If there be any truth in the hypothesis I have briefly outlined, there should be what I would term a kind of vital radiation going on and passing outwards from the body of a healthy person, which may not improbably excite by sympathetic vibrations in the bodies of weaker persons around them, vibrations of a normal or more healthy type than those present in the sick person.

"If this be true, the old belief of the efficacy of the laying on of hands, or of magnetic healing, may find some foundation, in fact, apart from what is most probably the general explanation of such causes, viz., hysteria.

"I have thrown out the above hypothesis of cerebral radiations with considerable doubt and hesitation as a suggestion only to those working in the field of telepathy or thought transference in the hope that I may thereby call the attention of such investigators to some phenomena in this very obscure field of research."

(Concluded from last week.)

WILD HORSES AND THE WILD WEST.

Colonel Cody, in ransacking all quarters of the earth in order to bring together a congress of races and types of the world's most celebrated horsemen at Earl's Court, has also assembled a most interesting and extraordinary concourse of steeds. Little as the casual observer may be struck by the variety of breeds introduced into the show, and of their specific origin, or rather, cause of variation, the equine student will find much to consider and induce reflection. Notwithstanding the numerous varieties extant, horses originated with a common or parent stock, and that they now differ in size, colour, gait, speed, etc., is undoubtedly due to natural selection, governed by the conditions of the country in which they are found, and to the purposes to which they have been applied, the conditions of existence, etc.

The horse is supposed to have been a native of the plains of Central Asia, but it should be observed that the wild species from which it was derived is not certainly known. In connection with the "buckjumpers" introduced by Colonel Cody, it may be asked if this peculiar vice is due to the hereditary memory of a former state domesticity, for it is admitted that the feral horses of America are domestic horses that have run wild. It is probably true also that most of those of Asia had a similar origin.

The true origin of the horse, however, goes back to much earlier periods, and the Asiatic horse, with its one digit, was, in turn, evolved from ancestors with polydactyl feet. Several instances are known in modern times, and more ancient records give instances of horses presenting more than one toe. Julius Cæsar's horse had this peculiarity. Its feet are described by Suetonius as having been almost human, with the hoofs cleft like toes. "It was born in Cæsar's own stables, and, as the soothsayers declared that it showed that its owner would be lord of the world, he reared it with great

care, and was the first to mount it. It would allow no other rider." The main functional toe of each foot of the horse is the third digit, corresponding to the middle finger of the human hand. In addition to these, two "splint-bones," one on each side of the main cannon-bone, are present beneath the skin—the remnants of two other toes possessed by ancestors of the horse. One or more of these splint-bones may become enlarged below and support phalanges, forming another digit beside the main one, or more commonly developing into a small external toe with hoof.

The occurrence of such extra digits in the recent horse is much more frequent than is generally supposed. The extra digit may appear on one foot, when it is smaller than the main digit, and is usually on the inner side of the fore foot. It may often be entirely under the skin, with the only external evidence of it a prominence, in which its form may be made out. A corresponding extra toe may be present on the other fore foot; a second extra digit may exist with the others, but outside the main digit; with the extra inner toes of the fore feet, another of equal or smaller size may be present on one or both of the hind feet, almost always on the inside; in rare cases, both fore and hind feet may each have two extra digits fairly developed, and all of nearly equal size; or sometimes, besides the extra toes already described, which appear to be the second and fourth, the first digit, or pollex, may be represented by its metacarpel, supported by a distinct trapezium, all beneath the skin.

A large majority of polydactyl horses to be found in the present day have been raised in the south-west of America, or from ancestry bred there, so that their connection with the mustangs or semi-wild stock of that region becomes more than probable. The fact that the tendency to reversion is much stronger where animals run wild must be taken into consideration in discussing the question of the origin of these animals, and the peculiar traits and characteristics exhibited by "Buffalo Bill's" collection. Apart from the equinal question, however, the Wild West rough-riders are a living example of ethnological evolution; they seem by habit to have become almost a part of the steeds they stride.

A TERRIBLE PROJECTILE.

What will happen when an irresistible force encounters an impenetrable body! The conditions of the case appear to be pretty nearly answered, so far as the force is concerned, by a shot which was fired from a 110-ton gun at a recent trial at Shoeburyness. The diameter of the gun was sixteen inches, and 900 pounds of powder were used in discharging the projectile, which was of solid steel, four feet in length, and weighed 1,800 pounds. These figures may serve to prepare the reader for the statement that the shot went through a plate of solid steel twenty inches thick, kept on through an eight-inch iron plate, twenty feet of solid oak, five feet of granite, eleven feet of solid concrete, and stopped—for it had to stop somewhere—in a brick wall six feet thick. Assuming these particulars to be correct—and the source from which we obtained them has an air of authenticity which seems to forbid the thought of scepticism—we have no difficulty in agreeing with the author of it, that the result was an astonishing one, and that a shot such as he describes would go through any two ironclads now afloat. The practical question is, if projectiles of this character come into general use, what kind of shelter or defence can be effectively opposed to them? Nothing short of a mountain would be a sufficient breastwork for a garrison which should be made the target for such an attack. It is the turn of the armour plate makers next, but if there is any limit to the game it surely cannot be far off.

SOCIAL SCIENCE.

POLITICAL BIGOTRY.

The spirit of bigotry in our politics is everywhere and constantly displayed, not as a characteristic of any particular party or class, but as a national trait and tendency. We habitually allow our courage and tenacity of conviction to betray us into fantastic and offensive expressions concerning our opponents. The vocabulary of disparaging epithets is exhausted in our efforts to defeat candidates and policies. There is nothing too violent for us to say of those who incur our displeasure or antagonise our interests by holding opinions and acting with organisations that differ from our own. We conduct our campaigns upon the theory that all the intelligence and patriotism of the country is monopolised by the element with which we happen respectively to be identified. The idea of conceding that there may be the same general sincerity and devotion to principle on both sides is not accepted in a practical sense, whatever boasts we may make as to our belief in the right of free thought and free speech. We refuse to grant to others the privilege that we claim for ourselves in the matter of preferring one party to another. This feeling is not acknowledged, of course, but it exists all the same, and is easily perceptible in our electioneering methods and appliances. We do not mean to be intolerant, that is to say, but such is the result in spite of our assumed liberality.

It is a singular fact that the average citizen is more obstinate in his political opinions than in his views upon any other subject. He does not always know how he comes by them, and is not always capable of defining and defending them, but he clings to them, nevertheless, as if they were a matter of life and death to him. The man who undertakes to change them is regarded as a conspirator against the integrity of his nature and the guarantees of his prosperity and happiness. He does not court controversy with the intention of testing the soundness of his doctrines, but for the purpose of insisting that they are unquestionably right, and that the person who rejects them must be either stupid or dishonest. The ordinary drift of political discussion is in the direction of confirming the individual in his preconceived faith. He resents the suggestion that he may be mistaken, much as he would repel an assault upon his private character. The fact that he belongs to a certain party precludes the possibility in his scheme of logic, that his position can be incorrect, and so it becomes an obligation of conscience with him to defend himself whenever contrary arguments are offered. He may not realise how completely he is at the mercy of his prejudices and superstitions, but the impartial observer can readily see it, and the effect of it is presented in that resolute adherence to party which he holds to be loyalty to his country.

This is not saying that partisanship and patriotism are necessarily incompatible. The truth is that they are entirely consistent with each other, and are usually found together. Ours is a Government of parties, and the will of the people is ascertained and executed through such organisations. The voter must join a party in order to make his ballot count for something in the solution of current problems and the adjustment of public affairs. He simply votes in the air when he votes outside of party lines. It is a delusion to suppose that each citizen has a given amount of political power regardless of the manner in which it is exerted. Separate votes are effective only when

combined and concentrated, which is merely another way of affirming that parties are indispensable. No better way of promoting justice, the chief business of nations, has yet been discovered. If there were no parties there would be no adequate facilities for the operation of those random and uncertain forces by which our political destinies are controlled. There can be nothing accomplished in the domain of politics without organisation. The voters who agree with regard to certain general propositions or sentiments must act in unison, or they cannot make any positive and permanent impression. That is the explanation and justification of the party system. It provides means for the people to exercise their authority in a methodical and conclusive manner; and the results show that, with all its faults, it is a decided success.

The principles and purposes of parties may be said to constitute the religion of politics. Men believe in them as they believe in theological dogmas and institutions. They inspire a kind of zeal that leads almost inevitably to arbitrary and intimidating processes. The other side of disputed points is not fairly and candidly considered. There is no other side, in fact, for the man who is thoroughly devoted to his party. Force of habit causes him to exaggerate the righteousness of his faith, and to depreciate the value of adverse theories and influences. He becomes a bigot, in other words. The suggestion of a possible quality of goodness in things that conflict with his views is dismissed as an absurdity. He not only denounces the opinions of his opponents, but he also questions their motives and impugns their personal honesty. His philosophy is lop-sided, and makes no allowances for differences of judgment, education, and association. He is so well convinced of the correctness of his conclusions that he has no patience with those who are unable for any reason to agree with him. His fidelity is admirable as such, but he invests it with a degree of arrogance that is open to criticism, and his temper too often makes him insolent and unjust. He is very much in earnest, and so he unconsciously forgets to observe the amenities of life in his comments upon the actions of other people.

It is manifest folly to suppose that one party has absorbed all the wisdom and goodness in the land. The lines upon which parties divide relate to matters upon which men can properly entertain antagonistic opinions. There has never yet been a party that was controlled by its ignorant and wicked elements, strictly speaking. The men of intelligence and character are always predominant. No party could survive under any other conditions. There are bad men in all parties, just as there are bad men in all the walks of society, but they do not shape party movements and are not the representatives of the prevailing party sentiment. We distinguish between the good and the bad in all other organisations, but when it comes to political parties we are curiously averse to drawing the line. A party may make mistakes and miss opportunities, but it cannot be inherently vicious and still maintain itself as a potent factor in the regulation of those matters which pertain to the general safety and utility of our political system. The bigots are gravely at fault in their theory of the perfect excellence of a particular party, or the perfect noxiousness of another. It is not true that any party is infallible and unassailable; and neither is it true that any party is wholly wanting in commendable qualities. The voter has a right to affiliate with the one that seems to him most conducive to the national welfare, and it is not necessarily an imputation upon his sagacity or his morality when he selects the one that his neighbour scorns and resists.

Where parties strive to attain their ends by aggressive means the individual soon learns to imitate the proceeding. He does not discuss questions; he hurls vocal javelins. The man who belongs to the opposing party is anathematised as a person who neither knows nor cares to do what is right. Differences of political belief are permitted to outweigh all the ties and influences that ordinarily mould private judgment and insure social harmony and happiness. There is sharp competition in the invention of derogatory stories. The air is filled with charges and countercharges, each party trying to prove its honesty by telling how dishonest its antagonist has always been. It is only now and then that one of these attacks is answered with evidence of its falsity. As a rule, the replies take the form of a retaliating accusation. This naturally tends to develop a spirit of personal obstinacy and malevolence which puts deliberation out of the question. The voter reads newspapers and listens to speeches mainly for the purpose of increasing his stock of harsh and annoying expressions. He is determined not to be outdone in calumny. The duty of defending his party is construed to signify an industrious dissemination of all the mean things that he can hear or imagine about the other party. It is the old fable of the pot and the kettle repeated in what is supposed to be a calm and impartial attempt to ascertain how the country can best be helped forward on its career of enlightened and unprecedented progress.

It is always well to remember, that parties are not the ultimate force in the conduct of our affairs. Behind and above them stand the people, representing that public opinion, which is the mind and conscience of the whole nation. This supreme power finally decides everything, and parties are successful only when they consult and respect it. There is no appeal from its verdicts and no way to divert it from its appointed course. It is indisputably sovereign. The parties are only instrumentalities for the declaration and application of that sober general thought, which is at once both the justification and the safeguard of our institutions. There can be no mischief done by the violence of party clamour so long as we have assurance of such protection. The people are to be relied upon in any emergency. They appreciate the value of the Government, and their intelligence provides a way of deliverance from every complication. If the parties fail to interpret popular opinion accurately, they will be discredited and overwhelmed. That is the lesson of our history. We have come safely through all of our past trials by reason of the strong common sense of the masses, and the same beneficent and resistless influence will answer the same purpose in the future, whatever dangers may ensue.

There will be political bigotry in this country always, undoubtedly. It is one of the effects and accompaniments of our political system, and of our habits of thought and action. But we can afford to review it with serene indulgence. It does not in any sense detract from the magnificent truth that the people are the source of all political power, and that popular opinion quietly and surely brings the best results to pass, regardless of all intervening heresies and conspiracies. The bigotry that does nothing worse than to quicken interest in public affairs, and to make campaigns energetic and determined, may safely be left to pursue its way unmolested. It does not prevent the adjustment of important questions in accordance with the precepts of justice and the admonitions of patriotism. At the worst, it only makes men and party look absurd sometimes, and that is not a thing to justify serious protest. The men of

bigoted propensities, are not apt to be lacking in love of country and pride of citizenship. They are unpleasant to those whom they assail, but they are preferable to men who never take any part in politics for fear of giving offence. It is better to have bigots than cowards. The man who strives to perform his political duties in an earnest and effective way, even though he may occasionally hurt somebody's feelings, is more to be honoured and commended than the one who supereiliously declines to render such service, and then complains because the elections do not go to suit him.

WATER AND AIR BAROMETERS.

A barometer is an instrument designed to measure the weight, or pressure, of the atmosphere as it varies from time to time. The absolute weight of a column of air of any given size is equal to the weight of a similar column of mercury about 30 inches in length, or, for a column with an area of 1 inch, 15 pounds. An accurate mercurial or aneroid barometer requires much skill in its construction, and is necessarily a rather costly instrument; but for many purposes it is not necessary to measure the actual pressure of the air, but only the variations of pressure, and for this purpose there are a number of simple devices which answer the purpose perfectly, and can be made out of the cheapest materials.

It is evident that if a quantity of air is sealed up in a vessel, the pressure of the inner and outer air on the sides of the vessel will be equal as long as the pressure of the outer atmosphere remains unchanged, that is, as long as the barometer remains at the same height. But the pressure of the atmosphere is constantly changing, and if, after the vessel of air is sealed up, the atmospheric pressure increases, there will be an inward pressure upon the outer sides of the vessel. If, on the contrary, the atmospheric pressure diminishes, the pressure on the vessel is from within outwards.

Now, if by any means we can make these changes of pressure visible, we shall have a very good barometer, which will indicate the changes of atmospheric pressure quite accurately; and one of the easiest ways to do this is to connect a tube filled with water with the interior of the vessel, so that the height of the water in the tube will vary according to the difference of pressure between the outside and inside of the vessel. A curious barometer of this sort, over a hundred years old, now in the collection of M. Tissandier, the editor of *La Nature*, consists of an ornamental glass flask, with a single opening in the side, to which is attached a glass tube bent upwards at a right angle. The flask is filled with water to a point above the opening, thus making it air-tight; and the varying pressure between the outer and inner air is indicated by the rise and fall of the level of the water in the tube, which can be roughly measured by using the ornamental corrugations of the glass as a scale.

A much better and simpler apparatus is made from an ordinary bottle, provided with a well-fitting stopper, preferably of rubber, though cork will answer, if previously soaked in melted paraffin or tallow. The stopper is perforated, and a glass tube, about a yard in length, and open at both ends, is passed through it to the bottom of the bottle. Before putting the apparatus together, the bottle is filled about one-quarter full of water, and the tube almost entirely full. If the upper end of the tube is kept closed by the finger, or otherwise, the water will not run out, even when it is inverted. The column of water should stand a few inches below the top of the tube, and will rise and fall according as the pressure of the atmosphere diminishes or increases. That is, when the ordinary mercurial barometer rises this water barometer will fall, and *vice versa*.

An objection to these barometers is that they are even more sensitive to changes of temperature than of pressure, and on a warm day the column of water will rise in the tube, notwithstanding the tendency of an increased atmospheric pressure to depress it. This can be avoided by burying the bottle in the ground, so that only the tube shall project above the surface. In such a position the daily variations of temperature are so small that they may be neglected. The same result may be obtained by placing the apparatus in a cellar or any other location where the temperature is nearly constant.

An improved form of air barometer, which is of actual scientific value, consists of a glass tube, on one end of which is blown a glass bulb, the other end being left open, but slightly narrowed by heating in a flame. A small quantity of mercury is introduced into the tube, to serve as an index. When the barometer is placed with the bulb downwards, the pressure on the air in the bulb equals the outside atmospheric pressure, plus the weight of the mercury; when this is reversed, it equals the outside pressure, minus the weight of the mercury. By suspending the instrument successively in the two positions and reading the different heights of the mercury on the scale, the actual atmospheric pressure may be calculated by tables.

The varieties of air and water barometers described above have more or less scientific interest, and serve very well to indicate a high or low atmospheric pressure, but they are by no means accurate, and where exact and absolute measurements of the varying weight of the ocean of air surrounding us are required, nothing can take the place of the aneroid barometers, which are now made and graduated so carefully that they will indicate the difference in pressure between two different storeys of the same building.

WAS AVERNUS A REAL OR IMAGINARY LAKE?

Lake Averno, the ancient Avernus, is no figment of the poet's imagination, but a substantial reality. It lies in the crater of an extinct volcano, about eight miles from Naples, and although less than two miles in circumference, is so deep that in some parts no bottom has been found by the longest line than can be used. It is fed by springs and has no natural outlet; but Agrippa, in the first century, made a canal to lead its waters to the sea, and also connected it with other lakes in the same neighbourhood. The passage was closed by an earthquake in 1538 and the lake now has no outlet. In ancient times the surrounding scenery was very forbidding; the water was believed to be poisonous, and from crevices in the rocks surrounding the lake sulphurous vapours were continually exhaled, while the wild, rugged crags and the frowning edges of the crater bore so evil an aspect that, by tradition, it was believed to be the entrance to hell. The appearance of the scene has greatly changed. The woods on the outer slopes of the volcano ages ago disappeared. There are now no volcanic phenomena, and the mountain is much reduced in height; but still Lake Averno, by the residents in the vicinity, is regarded with superstitious dread.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

OUR PHOTOGRAPHIC COMPETITION.

The result of our Photographic Competition has exceeded even our most sanguine anticipations. We confess our surprise not only at the interest this competition has excited, but at the large number of our readers who practise photography. The productions of the majority are not alone highly creditable, but equal at least the work of some of our first professional photographers. Eleven hundred and ninety-eight competitors entered for the prizes we offered, and the total number of prints, lantern slides, and definitions sent in reached the astounding number of 5,572!

The judges have had a most difficult task in awarding the prizes where so much of the work has been almost equally good, and, taking this into consideration, the proprietors of SCIENCE SIFTINGS have decided to award consolation prizes of photographic dry plates of the celebrated Fry's "Kingston Special" brand to those competitors who so nearly approached the winners in their results. Without more preface we will proceed at once to give our readers the result of the competition :—

No. 1 Competition.

For the best landscape photograph by an amateur, a two-guinea detective camera has been awarded to Mr. EDWARD SAMPSON, Beauchief-abbey, near Sheffield, for his photograph entitled, "A Summer's Evening," an exquisite production, showing a group of cows grazing in a meadow in twilight.

MR. S. FRANCIS CLARKE, of Louth, Lincolnshire, has run Mr. Sampson extremely close with a series of six charming views, and to him we have forwarded three dozen $7\frac{1}{2} \times 5$ "Kingston Special" dry plates.

MR. W. H. HAYLES, of Union-road, Cambridge, makes a good third with his "Cottage Homes," and a consolation prize of two dozen "Kingston Special" whole plates have accordingly been sent to this gentleman.

In this competition we may specially mention the work of the following as running the winners very close :—

Mr. Chas. W. Brumwell, 7, Lower-terrace, Notting-hill, W.; Mr. Edward Brightman, of Redland-road, Bristol; Mr. William Morgan Thomas, 54, Wayford-street, Clapham Junction, S.W.; Mr. H. C. Bentley, Louth, Lines; Mr. G. W. Swinnerton, 11, Ferme Park-road, Stroud-green; Mr. William C. D. Hills. 17, Redcliffe-gardens, South Kensington; Mr. W. E. Kieffer, 1, Vicarage-terrace, Sunderland; Mr. Ethelbert Clarke, 145, Stanstead-road, Forest-hill; Mr. W. Northwood, High-street, Wordsley, near Stourbridge; Mr. F. W. Rodwell, 13, Blenheim-terrace, N.W.; Miss Dunmore, 68, Liverpool-road, South Birkdale, Southport; Mr. Hugo Mevnell, Farley, Cheadle, Stoke-on-Trent; Mr. George Harding, Wordsley, Stourbridge; Mr. John Coates, Mossvale Cottage, Dunmurray, Belfast, Irelaud.

The following competitors' work for this prize is fairly good, and deserving of honourable mention :—

Dr. W. E. St. L. Finney, Norbiton, Surrey; S. Watson, Burford; P. E. Hawkins, 11, High-street, Leighton Buzzard; A. C. Townsend, 55, St. Peter's-road, Birmingham; E. G. French, 64, Stonefield-road, Hastings; Geo. Pawson, 11, Blossom-street, York; F. W. Smethurst, 79, North-street, Mare-street, Hackney; T. P. Rogers, 44, Manor-road, Brockley, S.E.; A. G. Ellis, 6, Hermitage Villas, West-hill, Highgate, N.; H. Bradley, Yarm; W. Northwood, High-street, Wordsley, Stourbridge; S. Watson (no address); Wm. F. Closs, 37, Watson-street, New Cross-road, S.E.; F. W. Baxter, 170, Church-street, Stoke Newington, N.; G. W. P. Norton, 70, Winter-street, Sheffield; E. Cash, 104, Grayshott-road, Lavender-hill, S.W.; C. D. Owen, 4, Harbour-road, Camberwell; Jno. L. Hughes, 10, Carlingford-street, Liverpool; Jas. P. Hunt, 38, Church-street, Harpurling, Manchester; L. Moonen, 6, College-villas, N.W.; J. W. Horton, Bradford Wharf, Lincoln; Stephen Dean, Holly-bank-road, Lindley, Huddersfield; F. Ellingworth, Northgate-cottage, Oakham; A. Watson, 18, Great Northern-street, Huddersfield; Ernest Hurnan, 89, Aston-street, Birmingham; A. T. Crane, 1, Melrose-villas, Church-end, Finchley, N.; T. James, 60, Broad-street, Worcester; George Harding, Wordsley, Stourbridge; W. Herbert, 74, Metal-street, Cardiff; F. G. Welch, Widemarsh-street, Hereford; John Taylor, 12, Merridale-lane, Wolverhampton; S. Watson, Burford; W. S. Crampton, 6, Rocky-lane, Nechells, Birmingham; H. D. Metcalfe, Smithy Carr-lane, Brighouse, Yorks; Miss H. E. Dunmore, 68, Liverpool-road, South Birkdale, Southport; F. W. Rodwell, 13, Blenheim-terrace, N.W.; S. Watson (no address); Percy G. Storey, 27, Blenheim-terrace, N.W.; W. E. Thompson, 21, Lasso-road, Hammersmith; Edward F. Clark, Tramore, Heslop-road, Balham, S.W.; A. J. Hardwick, 13, Portman-street, Taunton; W. M. Thomas, 54, Wayford-street, Clapham Junction, S.W.; Frank Daniels, 49a, Clifton-hill, New-cross, S.E.; E. A Culver, 165, Queen's-road, W.; J. F. Hesse, 30, Arthur-street, Wells-street, Hackney; S. R. Hallam, Devonshire-house, Beauchamp-road, New Wandsworth, S.W.; Louis Liversedge, 14, Queen's-road, Great Crosby, Liverpool; W. E. C. White, Vicarage, Stonehouse, Glos.; C. H. Thomas, Lanteglos, Glebe-avenue, Enfield; J. Thomas, 1, Grugos-terrace, Port Talbot.

The work of the remaining competitors for this prize, to the number of about one hundred and fifty, though creditable in some instances, for young amateurs, is, on the whole, somewhat poor.

No. 2 Competition.

For the best portrait by an amateur, has resulted in most excellent work, and the prize has been awarded to Mr. J. W. EVANS, 52, Darlington-street, Wolverhampton, for two exquisite whole-plate portrait studies, entitled :—"Only a Street Arab" and "A Bit of News." The pose of the models in these photographs exhibits a true artistic spirit.

Mrs. S. F. CLARKE, of Upgate, Louth, follows Mr. Evans very closely with four superb 10×8 portraits, printed in bromide, and to her we have forwarded two dozen 10×8 Fry's "Kingston Special" Dry Plates.

Decidedly third in order of merit in this competition, is Mr. CHAS. W. BRUMWELL, of 7, Lower-terrace, Notting Hill, W. He sends a perfect little gem of a child study, printed on chloride paper. We have sent Mr. Brumwell a consolation prize of three dozen $8\frac{1}{2} \times 6\frac{1}{2}$ Fry's "Kingston Special" dry plates, and we have sent to Mr. EDWARD BRIGHTMAN, of Redland-road, Bristol, two dozen whole plates of the same brand, for some good photographs, which though in other respects very meritorious, are, for portrait studies, somewhat hard.

The following came very near obtaining prizes in this competition :—

Chas. R. Townley, 9, Richmond-place, Holloway; H. Price, Kingswood-house, Kingswood, near Birmingham; Dr. W. E. Finny Kenlis, Queen's-road, Norbiton; Miss H. Dunmore, 68, Liverpool-road, South Birkdale, Southport; Percy G. Storey, 27, Blenheim-terrace, N.W.; W. Herbert, 74, Metal-street, Cardiff; W. M. Morgan, 54, Wayford-street, Clapham Junction; Edward Sampson, Beauchief Abbey near Sheffield.

Portraits sent in by the following, although not up to the merit of the foregoing, are highly commended :—

Chas. H. Thomas, Santeglos, Glebe-avenue, Enfield; W. Murray, 5, Sheppard-street, New Swindon, Wilts.; A. Goodiff, 13, Blenheim-road, St. John's Wood, N.W.; F. G. Welch, Widemarsh-street, Hereford; L. Mooner, 6, College-villas, N.W.; J. F. Hesse, 30, Arthur-street, Well-street, Hackney, N.E.; W. Herbert, 74, Metal-street, Cardiff; J. E. Ellam, Yarm; A. J. Hardwick, 13, Portman-street, Rowbarten, Taunton; J. Thomas, 1, Grugor-terrace, Port Talbot; F. Stutter, 83, Forburg-road, Clapton-common, N.; R. S. Vinter, Kimbolton-vicarage, St. Neots; J. T. Selby, Cavern-cottage, Margate; F. W. Baxter, 170, Church-street, Stoke Newington, N.; B. Hargrove, 25, Lancaster-gate, W.; George Harding, Wordsley, Stourbridge; W. E. Thompsou, 21, Lasso-road, Hammersmith; J. W. Horton, Bradford-wharf, Lincoln; S. Watson (no address); Harry Pritchard, 162, Orford-lane, Warrington, Lancs.; S. R. Hallam, Devonshire-house, Beauchamp-road, New Wandsworth, S.W.; E. A. Culver, 165, Queen's-road, N.; J. W. Laister, 20, Peterson-road, Wakefield; Charles H. Jelley, 52, George-street, Grantham; T. P. Rogers, 44, Manor-road, Brockley, S.E.; W. G. Clarke, Balham-house, Balham, S.W.; W. C. D. Hills, 17, Redcliffe-gardens, South Kensington; A. C. Townsend, 55, St. Peter's-road, Birmingham; E. G. French, 64, Stonefield-road, Hastings; Miss A. E. Dunmore, 68, Liverpool-road, South Birkdale, Southport; R. S. Vinter, Kimbolton-vicarage, St. Neots.

The results sent in by the remaining competitors, num-

bering nearly two hundred, call for no special comment.

No. 3 Competition.

The definitions in this competition are, on the whole, somewhat disappointing in point of numbers. For the best definition of a perfect landscape photograph, the prize has been awarded to MR. WALTER BARTON CLEVELAND, Waterloo-villa, Willoughby-street, Beeston, Notts, for the following :—

"A perfect landscape photograph must have one principal object or idea. It therefore follows that it must be so constructed and arranged that it will bring out that object or idea in the clearest and most emphatic manner possible, so that anyone who may be examining the picture may have no doubt whatever as to the object for which the photograph was taken. Moreover, the picture should be so arranged as to emphasise the principal object and to subordinate the others, so that it may give that variety which is so essential to make up a pleasing picture, yet at the same time does not distract too much attention from the principal object. The emphasis and subordination mentioned above should be secured by the proper arrangement of lines and forms, combined with the best effect of light and shade."

The undermentioned deserve honourable mention :—

M. W. Jones, Buckingham-house, Cleveland-street, London, W.; Mr. J. P. Hunt, 38, Church-street, Harpurley, Manchester; W. Northwood, High-street, Wordsley, near Stourbridge; J. C. Laws, 6, Commercial-terrace, Streatham-common; Sydney N. Glass, 79, Old-road, Skewen, Neath, Ireland; Albert Watts, 68, Packington-street, London, N.; F. J. Morgan, 77, Westminster-bridge-road, London, S.E.; John L. Hughes, 10, Carlingford-street, Liverpool.

No. 4 Competition.

The prize in this competition has been awarded to MR. JOHN H. CRABTREE, Warehouse, Wardle, Rochdale for the following definition of a perfect lantern slide :—

"A perfect lantern slide is that which, when projected on the screen, gives the nearest possible approach to what is actually seen in nature. The tones should be beautifully graded from the highest lights to the deepest shadows. The highest lights should be perfectly transparent; stretches of white sky should be avoided; wherever possible, clouds should be inserted suitable to the view beneath—fleecy cirrus clouds preferable to those of the heavy nimbus type. The shadows should reveal the finest detail. The deepest shadows should not contrast too strongly with the highest lights, consequently slides of great density are undesirable. One of the finest elements in a perfect lantern slide is its unlimited detail. Broad stretches of clear glass alternating with heavy patches of black deposit are destructive to perfect representation. Colour (chemically produced) may be pleasantly introduced, according to variety of subject. Landscapes may bear a warm brown or sepia colour, seascapes a bluish purple, and portraits black or purple. All uninteresting foregrounds and corners should be masked out. The cover-glass should be of uniform transparency, without specks, bubbles, or streaks, and the whole should be secured by neat and firm binding."

The only remaining competitors whose definitions are worth mention in this competition are the following :—

Mr. William Haigh Houghton, Lime Burn House, King's Mill Huddersfield; Mr. John C. Hughes, 10, Carlingford-street, Liverpool; L. Mooner, 6, College-villas, London-road; W. H. Hayles, Union-road, Cambridge; Douglas E. Cause, 63, Grand-parade, Bolton; E. A. Hutton, Broadbottom, Manchester; Thomas E. Short, 187, Beaconsfield-street, Newcastle-on-Tyne.

No. 5 Competition.

The lantern slide competition resulted in a very good show of excellent slides, the best are undoubtedly those of Mrs. S. F. CLARKE, Upgate Louth, Lincs, and the prize of a 12 × 10 Griffiths' enlarging camera has accordingly been sent to that lady. We congratulate Mrs. Clarke, and compliment her on the very high quality of her work.

Mr. EDGAR G. LEE, of 11, Beverley-terrace, Cullercoats, Newcastle-on-Tyne, and Mr. JOHN H. CRABTREE, Wardle, Rochdale, have sent in also some particularly fine work, and prizes consisting of four dozen and three dozen Fry's lantern plates have been sent to the respective gentlemen. The work of the following is also extremely good :—

R. Prince, Exchange, Birmingham; Jno. Taylor, Mendale-lane, Wolverhampton; Herbert Bentley, Louth, Lincs; Miss H. E. Dunmore, 68, Liverpool-road, South Birkdale, Southport; S. Watson; L. Moonen, 6, College-villas, N.W.; A. T. Crane, 1, Melrose-villas, Church-end, Finchley, N.; Louis Liversedge, 14, Queen's-road, Gt. Crosby, Liverpool; A. Watson, 18, Gt. Northern-street, Huddersfield; J. E. Ellam, Yarm; J. Thomas, 1, Grugos-terrace, Port Talbot; H. P. Metcalfe, Smithy Carr-lane, Brighouse, Yorks.; Harry Pritchard, 162, Orford-lane, Warrington, Lancs.; Jno. W. Wilshaw, 455, Shoreham-street, Sheffield; W. B. Cleveland, Waterloo-villa, Willoughby-street, Beeston, Notts.; R. J. Glanvile, The Retreat, Burnham, Somerset; H. Price, Kingswood House, Kingswood, near Birmingham; D. E. Causle, 63, Grand-parade Brighton; J. E. Hoad, 3, Goldsmith's-gardens, Acton, W.; H. Bradley, Yarm.

No. 6 Competition.

For the best photograph by an amateur of not more than twelve months standing, resulted in a very large number of entries. The prize of the Vever's Burnisher has been sent to Mr. CHAS. R. TOWNLEY, 9, Richmond-place, Holloway, N., and special prizes of three dozen and two dozen, respectively, of Fry's "Kingston Special" plates have been sent to each of the following :—H. PRITCHARD, 102, Oxford-lane, Warrington, and H. PRICE, Kingswood-house, Kingswood, near Birmingham.

The work, on the whole, in this last competition is extremely creditable, and that of the best of the competitors is distinctly better that many in the other classes. Among those whose work is deserving of special commendation are the following :—

Ernest Hunnan, 89, Aston-street, Birmingham; K. J. Miller, 1 Buckingham-road, Govan; William M. Thomas, 54, Wayford-street, Clapham Junction, S.W.; Charles B. Townley, 9, Richmond-place, Holloway, N.; W. E. C. White, The Vicarage, Stonehouse, Glos.; J. Thomas, 1, Grugos-terrace, Port Talbot; F. W. Smethurst, 79, North-street, Hackney; C. E. Bartlett, Fern-glen, Aldenham-road, Bushey; W. G. Clarke, Balham-house, Balham-hill, S.W.; A. R. Turner, 38, Winfield-mount, Leeds; F. J. O. White, 35, North-bank, Regent's-park, N.W.; Sydney N. Glass, 79, Old-road, Skewen, Neath; F. G. Welsh, Widemarsh-street, Hereford; A. G. Shephard, 260, Fulham-road.

Our labour in this competition is now ended. The task has been an arduous one, but we are more than repaid by the keen interest it has excited among our photographic readers.

We hope at a very early date to announce a fresh series of photographic competitions.

DETECTING TORPEDOES.

THE electric current, which is used for the propulsion of torpedoes is now used for their detection, as well as for that of mines in harbours and channels. The apparatus employed is very simple, and can be easily carried in a small boat. It comprises a metal sinker and a telephone, with batteries and induction coils. The sinker, which is attached to a small cable, is dragged along the bottom of the harbour where the presence of torpedoes is suspected. The operator in the boat or launch places the telephone to his ear and listens attentively. As soon as the sinker approaches a metallic body, such as a torpedo, a buzzing noise is heard, and this noise increases as the distance between the sinker and the torpedo is lessened, and becomes loudest when the two metals come into contact.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.
Or from Messrs. W. H. Smith & Son,
and through any Newsagent.

AN INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. I, price 1s., post free, 1s. 2d.

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

CURVATURE OF THE EARTH.

JOHN WILLIAMS.—The paradox referred to in your letter is apparent only. It is true that there are two ways of reckoning the earth's curvature; but one refers to the arc, the other to the chord of the circle. It was of the last that we spoke in the paragraph you refer to. Within moderate limits, it may be assumed that the chord of the terrestrial circle, joining the eye of an observer with the base of a distant vertical object, represents the hypotenuse of a right-angled triangle, of which the vertical object forms one of the sides. Hence the simple rule that the height of this object, when just visible, is proportional to the square of the distance along the chord, which, although not an absolutely accurate rule, is sufficiently nearly so for many practical purposes.

PERPETUAL MOTION AGAIN.

W. IZON.—Disregarding the unavoidable loss of energy that takes place in all transformations of mechanical work, you would still fail to generate energy by the use of your combined air-pump and air-motor. It is axiomatic that every manifestation of energy must have a cause. This cause is in every case described as being itself a form of energy. The fact that all known forms of energy, whether acting as causes or effects, possess fixed quantitative relationships one with another, has been deduced in the same way as the laws of gravitation, of chemical equivalence, etc., from an overwhelming array of experimental evidence. You are, therefore, recommended to waste no more time over attempts to generate perpetual motion by means of any of the forces hitherto rendered subservient to experiment. We cannot see the point in the concluding paragraph of your letter. Physical science can be mastered as perfectly by self-education as in any other way.

BAROMETRIC DETERMINATION OF HEIGHTS.

S. J. CASWELL.—If H and T represent, respectively, the barometric reading (in inches) and the temperature (in degrees Centigrade) at the lower place of observation; and if H_1 and T_1 stand for the same quantities at the upper place of observation, then the difference of level (in feet) will be given very approximately by the formula

$$52500 \left(1 + \frac{2\,(T + T_1)}{1000}\right)\left(\frac{H - H_1}{H + H_1}\right)$$

Not only must temperature be a factor in any strictly accurate formula for this difference of level, but variations in the intensity of gravity, the want of rigid compliance with Boyle's law, and the accidental conditions of stratification that exist throughout the atmosphere, each exercises an interfering influence. The exact height of the atmosphere has not yet been calculated, and is not known.

THE RIGHTS OF PRIORITY.

A. W. GILCHRIST, M.D.—We thank you for your friendly letter, but cannot assent to the view that Leverrier was before Adams in publishing the mathematical discovery of Neptune. Did not Adams communicate his calculations of the mass and location of Neptune to the Astronomer-Royal in October, 1845, while Leverrier's estimates were not communicated to the Academy of Sciences until June, 1846? It must be admitted, however, that since the calculations were undertaken quite independently, these two mathematicians are really entitled to equal credit. As to the other matters that you refer to, we regret that American writers and "scientists" very frequently adopt the labours of European workers without acknowledgment. And, in quoting from American sources (which it will be observed we seldom do), proper discrimination between that which is truly original and that which is not so, cannot always be exercised.

MISCELLANEOUS.

B. ROLSTOW.—We thank you for your suggestion, but we cannot see our way to deal more fully with mechanics just at present. We must endeavour to print that which is of most interest to our readers.

W. POOLE.—We do not know that sufficient experimental data are yet available for the construction of a formula giving the relations between speed and lifting power in air for rotating screw propellers.

READER.—The *Chemical News* is one of the most reliable journals of its class.

F. ELLINGWORTH.—There is no chemical that will penetrate into ruby glass and remove the colour from it. But with some kinds of "flashed" glass you might be able to remove the coloured coating by grinding it with emery.

E. KENNEDY.—We regret that we cannot entertain your suggestion that electricity and gravity are identical forms of force.

M. J. JONES.—Many thanks for your appreciation and your practical testimony to the same. Your suggestions as to illustrations we have had in view for a long time past, but we are unable to introduce them until we increase our size. We hope to do this before long.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers.

PRIZES FOR THE WEEK ENDING JULY 9th.

The senders of the first twelve letters, opened by us on Monday, July 11th, containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, the 11th instant, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 11th instant. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page ii. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors for the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

AWARDS.

The interest in this Puzzle is practically undiminished. We had the pleasure of receiving 127 solutions for the week ending. The largest number of correct solutions from one competitor was 34, although the nearest approach to this by any other competitor was only 12. The Prizes have been forwarded to the respective winners.

*** The Coupon will be found on page i.

Edwards' Isochromatic Plates and Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

DOMINION LINE

Royal Mail Steamers to Canada and the United States.

Direct and Shortest Route to America.

LIVERPOOL and BRISTOL

To QUEBEC and MONTREAL (in Summer).

To HALIFAX, PORTLAND. Maine, (in Winter).

Saloon, Second Cabin, and Steerage, at Lowest Rates

For further particulars apply to

FLINN, MAIN, & MONTGOMERY.

24, James St., Liverpool, & 70, Queen Sq., Bristol.

PATENTS FOR INVENTIONS.—If you have an idea for an invention, patent it for a small cost through Rayner & Co., Registered Patent Agents, 37, Chancery-lane, London. Trade Marks Registered, and Designs secured.

Messrs. Rayner & Co., have a large connection with Manufacturers and Capitalists for the development of Inventions. All particulars and pamphlet of information free.

£20 **TOBACCONISTS**

COMMENCING.

Illd. Guide, 229 pages (3d How to open respectably; £20 to £1,000." "TOBACCONISTS' OUTFITTING CO." (Reg.

186, EUSTON ROAD, LONDON.

N.B.—H. Myers' pamphlet on Various Trades post free.

Mgr. Hy. Myers. Est. 1866.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.,* 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, JULY 16, 1892.

SCIENCE NEWS AND NOTES.

"Whoso escapes a duty avoids a gain."
THEODORE PARKER.

Chronic Catarrh

is most remarkably prevalent among Londoners, and the inhabitants of other large English cities are also great sufferers from the same complaint. In fact, chronic nasal catarrh is so prevalent that even animals suffer from it, the dogs in the street being not uncommonly affected. Continental cities are comparatively free from the affection. In fact we have often heard of patients going to Paris or Berlin to obtain relief. Why is this? We do not think we need go further from the cause than the atmosphere we breathe. The air of London is filled with suspended matter of the foulest and filthiest kind, in the shape of dust particles ground from the pavements, ashes, the ejections of animals, the dried and pulverised sputa of a million persons, garbage, dead animals, and offal, besides the poisonous gases from factories and sewers. Then there is the soil saturated with illuminating gas, which is constantly being given off into the air. Repeated, neglected, acute, or subacute attacks of catarrh undoubtedly play their part by rendering the mucous membrane more vulnerable, and exceptional cases may even give rise to the disease when the patient is continually exposed, and the parts, in consequence, frequently congested; but it is the filthy condition of the atmosphere we respire that constantly irritates the unprotected mucous membrane, and it is the prime factor causing and perpetuating the hyperæmia, the swelling and the tumefaction—the condition, in short, which we recognise as chronic catarrh.

A Changeable Climate,

particularly if damp, may favour the development of catarrh, and it is here that we must look for the reason of the comparative exemption of Continental cities. In a locality where the temperature is variable acute attacks will be more frequent, and the patient, owing to the abrasions of the membrane that may result from frequently blowing the nose, will have the nasal orifices in an inflamed and irritable condition, easy of attack by the dust and contaminated air. The condition of our houses is also answerable for much. Carpets, for instance, keep the atmosphere loaded with impurities in the form of suspended matter, every footfall sending it up in imperceptible clouds. If the quality of the atmosphere has nothing to do with catarrh, why is it that clerks and shop girls are peculiarly susceptible to catarrh, and labouring men and those whose occupations keep them out of doors, and consequently in a better atmosphere, are comparatively exempt? Another reason that may be advanced for the immunity of Continental cities is that in most cases they are better planted with trees.

The Dependence of the Brain upon the Blood

was, through personal experience, brought very sharply to the attention of Dr. Lauder-Brunton. He was called upon one night after a long day's work to write an article immediately. He sat down with pen, ink, and paper before him, but not a single idea came into his head, not a single word could he write. Lying back he soliloquised: "The brain is the same as it was yesterday and it worked then, why will it not work to-day?" Then it occurred to him that the day before he was not so tired and probably the circulation was a little brisker. He next thought of the various experiments on the connection between cerebral circulation and mental activity, and he concluded that if the blood would not come to the brain the best thing would be to bring the brain down to the blood. He laid his head flat down upon the table and at once his ideas began to flow and his pen began to run across the paper. He thought: "I am getting on so well I may sit up now," but the moment he raised the head his mind became an utter blank, so he put his head down again flat upon the table and finished his article in that position. Stimulation of some branch or other of the fifth nerve seems to increase the circulation in the brain and those who are making their utmost calls upon their mental powers are accustomed to stimulate this nerve one way or another. The late Lord Derby used to eat brandied cherries, and an experiment of Marey's proves that mastication will accelerate the flow of blood through the carotid artery, and serves to show the wisdom of an editor who used to eat figs while writing a leading article and even of those who indulge in the practice so disagreeable to their neighbours of chewing tobacco. Others stimulate the gustatory branches of the fifth nerve by the sweets which they suck or by the smoke of a cigar or cigarette; while a rustic called upon suddenly to answer a question will probably excite the cutaneous branches of this nerve by scratching his head, and a man of more culture may stroke his moustache or beard, press his forehead or eyes, or, like many Germans, smite his nose with the forefinger.

While Stimulation of the Fifth Nerve

as just described tends to keep people awake and increase their mental activity, gentle, rhythmical stroking of the head tends, on the contrary, to make them fall asleep, and brushing the hair has this effect on many people to such an extent that the movements of the hairdresser's fingers over the scalp and rhythmical click of the shears will send some people to sleep, even at the risk of having their hair shorn to a much greater extent than would be at all pleasing to

them on awakening. A gentle rubbing of the scalp, Dr. Lauder-Brunton points out, as if to loosen it upon the skull, also tends not only to sooth irritability, but to relieve and to prevent headaches. Position is everything, we were taught in our youthful deportment classes, and from Dr. Lauder-Brunton's paper on the physiology of posture, we should consider it is. As we walk along the streets and notice the difference of attitude in the passers-by, some with head erect and agile steps convey to us at once the idea of energy and activity, while others with hanging heads and bended knees suggest the ideas of languor, weakness, and depression. It is a matter of ancient observation, Dr. Lauder-Brunton points out, that such an attitude as this is associated with weak circulation.

When the Heart is Stimulated by Joy or Hope

the attitude becomes again erect and the gait brisk and elastic. It is by no means easy to distinguish exactly between the part played in this change by the motor cells of the nerve centres and by the circulatory apparatus, for the activity of the motor cells on which muscular action depends is itself influenced to an enormous extent by the circulation of blood through the nerve centres. We find an example of this in the attitude unconsciously assumed by anyone engaged in conversation or argument. So long as he takes only a listless interest in the subject he may lie back in the chair with his legs crossed and his arms either hanging down or his hands laid loosely in his lap. As his interest increases his attitude becomes more erect, and he sits straight up, with his hands folded or laid upon his knees instead of hanging listlessly down. As his interest increases still further the body is bent forward at an angle and the hand is very probably placed firmly on the thigh. If he becomes excited in the heat of argument the body is bent forwards at a somewhat acute angle and the hand is stretched out in front and somewhat upwards as if to help the words which flow from his lips to drive the thoughts which are rapidly evolved from his brain into his opponent's mind. In this position the flow of blood through the arterial system onwards to the brain as well as its return backwards through the veins seems to be particularly easy.

This Position

is not only assumed during the heat of argument, whether the speaker be sitting or standing, but when one is led to assume it unconsciously it seems to give rise to a rapid and sometimes almost uncontrollable flow of ideas. Thus it occasionally becomes a cause of remorse to devout souls, who during the attempt to pray in church in this attitude are sadly distracted by crowds of ideas which at once disappear on the assumption of an easy sitting posture. The circulation in the cerebral vessels and the current of ideas in the brain are very delicate things and may be modified by very slight causes; thus an attitude with the head drooping slightly and with the chin supported upon the hand is the one frequently assumed in deep thought, with concentration of ideas upon a single subject and no desire for immediate expression. The touch of the hand upon the head seems to have a directing power over the thoughts. The contact of the hand with the temples seems as if it could hardly by any possibility modify the circulation in the brain or the feelings of the individual, and yet it appears to have an actually soothing effect and to be a real physical solace in cases of grief and depression. At the same time the greater droop of the head possibly provides for a better supply of blood to the sensory parts of the brain in the posterior part of the head and thus to a certain extent counteracts the general weakness of the circulation. In the case of excitement, the head being more raised, if a straight line were drawn through the axis of the body so as to represent the line of the aorta and carotid arteries, it would come out at the anterior part of the head; and blood driven onwards in this line would supply nutriment rather to the motor than to the sensory centres.

External Temperature has a Powerful Effect

in determining posture. On a hot summer's day the natura tendency is to lie down with the head slightly raised, the arms hanging loose and one leg extended, while the other perhaps is drawn up. The physiological reason for this posture is that in it the greatest extent of cooling is attained, for it insures the greatest possible exposure of the largest vascular district in the body—viz., the intestinal vessels—to the cooling influence of the external air. This is aided by the loss of heat due to the evaporation of sweat. By the slight raising of the head and the drawing up of one leg the abdominal parietes are rendered loose and the intestines tend to fall sideways and the abdomen tends to become flattened from before backwards. The greatest extent of cooling surface is thus obtained and the temperature of the body is kept as low as possible. An entirely opposite attitude is assumed when the external air is cold. The thin abdominal walls being insufficient to protect the intestinal vessels from the cooling influence of the external air, the legs are drawn up until the thick muscles of the thigh form a warm covering to the abdomen and thus prevent loss of heat from the intestinal vessels. Many people are unable to get to sleep when they are at all cold, and Rosenthal has shown that this attitude is commonly adopted by men, dogs, and other animals when preparing to sleep so as not only to maintain the bodily temperature during sleep, but to allow the intestinal vessels to dilate and accommodate a mass of blood which would otherwise be driven into the cerebral circulation, stimulating it to functional activity and keeping the person or animal awake.

A Remarkable Sea-calming Invention

has just been submitted to the French Salvage Society by one Baron d'Allesandro. It consists in covering the surface of the sea with a specially prepared insubmergible and imputrescible thin netting. This reticular fabric does not rise sensibly above the surface, and does not offer resistance to the wind; and it plays, it is claimed, the part of a bed of oil in that it has the effect of stilling the waves and rendering navigation safer and less difficult. Baron d'Allesandro's idea is born of the circumstance that sailors have frequently observed the calm produced by the floating seaweed technically known as filum, which is met with in various parts of the North Sea. His netting is said to imitate exactly the nature and characteristics of this marine plant of the Algæ class. Experiments with the new wave-stiller have been conducted outside the breakwaters of the Quiberon Peninsula. A netting one thousand yards square, with a mesh of five centimetres, and edged with a strong bolt rope, was used; and the results obtained are stated to have been so satisfactory that the French Minister of Marine has appointed a special commission to investigate and report on the invention.

An Elastic Vegetable Material

has recently been imported into this country from Oran, an Algerian port on the Mediterranean Sea, which is said to possess the quality of being so elastic that it can be used as a substitute for springs and the like in the manufacture of

furniture backs and seats. This material is so expansive, and so easily affected by high temperatures in its dry state, that, when packed, the bales have to be held in place by means of heavy steel bands. The peculiarity of this grass is that it thrives only around the volcanic slopes of Oran, and flourishes up to within a short distance of the craters themselves, the latter being always in a semi-active state, and the earth around so warm that not a plant of any kind can thrive or is ever seen to grow, except this steel-like product.

Character Telling by the Teeth

is a new science that has been suggested by some recent comments emanating from Sir James Crichton Browne. He considers it obvious, as the result of examining a large number of idiot children, that the condition of the several teeth in the weak-minded will sometimes guide to the particular point in the evolution of the nerve centres when arrest in development took place, while the distribution of caries amongst their teeth will throw light on some obscure questions in dental pathology. He points out that certain types of teeth are characteristic of certain varieties of mental defect, and it is possible, therefore, that certain less marked, but still, perhaps, distinctive dental characters, are associated with certain mental qualities in those who are not weak-minded, and that dentistry might afford glimpses of insight and prescience to which palmistry has only pretended to attain. It is obvious, above all, that cerebral abnormalities, congenital and developmental, have associated with them dental malformations and degenerations of an exceedingly marked kind, and it is probable, therefore, that cerebral disorders in the young when dentition is still incomplete may impair the soundness of the teeth, and so the nervous high tension of the age, which is so apt to induce cerebral disorder, may be a contributory cause of the increase of dental caries in these days.

Physical and Mental Correlation,

or the constant correspondence between the development of the physical organisation and the intellectual capacity, is a weighty doctrine with anthropologists. So far as the relation between brain-structure and mental ability is concerned, probably no one who has himself studied the facts will deny this. But, in another direction, scientists are less in unison, and that is where the question of personal beauty is concerned. Even so competent a physical anthropologist as Topinard repeats in his last work the assertion that there is no fixed canon or norm of human beauty; that it is merely a local and factitious notion, and is devoid of weight as a general factor of evolution. This narrow opinion has, it is true, the sanction of Darwin, Humboldt, and the whole school of association philosophers; but how erroneous it is will readily be seen by reflecting on the application of the law of correspondence. Leaving aside obviously aberrant and morbid forms, such as mutilations and artificial deformities, it will be found that the underlying motive of the beautiful is that of highest function, which is inseparable from highest capacity.

The Conditions Required for Such Result

are health, physical development, corporeal symmetry, and the culture of that which is peculiarly human as distinguished from what is merely animal. When nations have ideals of beauty contrary to these principles, it is an indication of low culture and capacity. As they advance in these their ideals steadily approach a definite and the same conception of the perfect human form; though it is not to be expected that the species will ever unite on any one fixed canon, because it is in the very nature and essence of the ideal that it can never become cabined, cribbed, confined within the material fetters of the real. One of the few anthropologists who have recognised and pointed out this gradual evolution of the ideal of beauty in the history of the species is Prof. Gerland, of Strasburg, in his treatise on general ethnography.

The Fundamental Question in Anthropology

is the origin of the differences in the human species. These differences begin with those visible in every individual, and extend up to those broad and permanent traits which distinguish the sub-species of man from each other. Beyond this they nowhere go; that is to say, no "missing link" exists which connects in an uninterrupted chain the human with any other vertebrate. In explanation of this phenomenon of indefinite variation within fixed limits, M. Ch. du Pasquier has published an ingenious theory in the *Bulletin de la Société d'Anthropologie de Paris*. He suggests that the fixity of the species, instead of being an argument against the theory of evolution, is the natural carollary of of its two great factors, (1) The law of constant variation, and (2) The law of fixed heredity. These act with like mechanical inflexibility as the motions of a pendulum, always moving but unfailingly self-limiting, and thus determining the invariability of the specific type, while leaving a wide range for racial and individual variability. His argument is lengthy and ingenious, and well worth close reading. In such a study, where especially the characteristics of races are the chief topics of investigation, the anthropologist will act wisely if he follows closely the track of the general zoologist. With a few easily explained exceptions the areas of characterisation of the species man are identical with those of the higher living vertebrates; and it is very significant that zoologists acknowledge that no two of these regions are of equal rank in their capacity for the development of organic forms. This has direct bearing on the deep-seated differences between races, and explains how they can be radically diverse and yet members of the same species.

The Theory of Relation Between Sun Spots

and the late cold weather, treated by Mr. E. Kennedy, in a recent issue of SCIENCE SIFTINGS, has brought forth an antagonistic theory from Mr. E. Reginald Blakely. Mr. Kennedy wrote:—"Knowing that sun spots are caused by an explosion, say gas, would it not cause the heated photosphere to rise irregularly in a sort of circle, after the style of a crater? As the influence of this hill of heat was felt upon the earth, would it not raise the temperature exceptionally high?" Mr. Blakely takes this to mean that the photosphere round a spot gives us this extra heat. Now, it was shown long ago by Huny, Secchi, and Langley, he points out, that the umbra of a spot gives us 54 per cent. less, and the penumbra 80 per cent. less than the surrounding photosphere. "We have no evidence," Mr. Blakely continues, "that the photosphere round a spot radiates more heat than that on any other portion of the disc. If it did so, I think it is pretty obvious from what I have shown that this extra radiation would be quite counterbalanced by the less radiation of the spotted surface, especially when we remember that the great February group of spots covered 3,530 millions of square miles. Why does Mr. Kennedy think that April 1 to 16 should be warm through this cause, for, if his theory were correct, the time of the greatest heat should have been the middle of February, when the spotted group covered the area mentioned above, and it had dwindled to 250 million square miles by March 4, and, so far as I have heard, has never recovered anything of its size since."

GLEANINGS OF THE GLOBE.

At a Highland farm a pig was detected in the act of milking the cows.

Ladies complain that the incandescent lights in ball and supper rooms reveal defects of complexion and feature not observable under other light. This may be obviated by covering the incandescent lamps with pale yellow silk, when quite the opposite effect will be noticed.

Bricks made of glass are of very superior quality. A sand of iron and glass is forged into a mould under several pounds pressure; it is then subjected to extremely high heat, which causes glass and sand firmly to unite. The bricks are perfectly white, and will stand both frost and acid.

A "Cloud Atlas" has been patented by Mr. Kennedy. It is a most important looking work, and, we should imagine, useful to the unweatherwise. Although we have only consulted it once, the results were perfectly accurate. A series of elegant pictures illustrate the weather at the moment, and underneath is printed the forecast.

Inventors are usually in excess of the demand, but the Indian Government is literally hungering for some ingenious individual to make a cartridge case that will be destroyed by the discharge of the rifle. Empty cartridge cases can be refilled, and as quite a trade is being done in them by the natives, the officials are quite alarmed.

The chief element in the composition of a tear is water, but with water are associated minute proportions of salt, soda, phosphate of lime, phosphate of soda, and mucus, and and when seen under the microscope, a tear, after evaporation, looks like a very small fish bone, owing to the salines forming themselves into lengthened crosslines.

The Krupp Works at Essen contain 2,542 furnaces, 430 boilers, 83 steam hammers, 21 roll-trains, 450 steam engines, and 1,652 machines for various purposes. The number of cannon turned out is over 21,000, and more than 20,000 workmen are employed. An average of 1,666 tons of coal and coke is consumed daily at the works.

Mr. Sims, one of the inventors of the Sims-Edison torpedo, has prepared drawings of a life-boat made on the same principle as the now famous torpedo. The propeller is to be placed in the stern of the boat, which is to be provided with three or four miles of cable and an electric search light. The current for propelling the vessel can be generated at a shore station several miles from the starting point of the lifeboat.

The Royal Botanical Society has recently been paying much attention to coffee-tea. It has been estimated that the percentage of theine in the leaves of coffee is 1·26 as against 1·00 in the beans. As the leaves may be easily grown in many parts of the world where it is difficult to insure good crops of coffee beans, it might prove a valuable agricultural product in many of our warmer colonies. At present, only some 2,000,000 of men use coffee-tea, in comparison with 110,000,000 who use the bean, and 500,000,000 who drink Chinese and Indian teas.

The eyes of insects are immovable, and on this account Nature has provided them with a sight-seeing apparatus that is cut into a multitude of little planes or facets, like those on a diamond. Each of the facets, the naturalists tell us, possesses all the properties of a true eye. Leuenhoeck counted 3,181 facets in the cornea of a beetle, and 8,017 in the eye of a horse-fly. Some species of insects have not less than 40,000 facets to each eye.

Herr Weismann, a distinguished German biologist, has pointed out that the average duration of the life of birds is by no means well known. Small singing birds live from 8 to 18 years. Ravens have lived for 100 years and parrots still longer in captivity. Fowls live from 10 to 20 years, while the wild goose lives over 100 years. The long life of birds has been regarded as compensation for their lack of fertility and the great mortality of their young.

A curious and interesting calculation has been made by a Washington professor on the dynamic power of coal. According to the professor, a single pound of good steam coal has within it dynamic power equivalent to the work of one man for one day. Three tons of the same coal represent a man's labour for the period of twenty years, and one square mile of a seam of coal, having a depth of 4ft. only, represents as much work as 1,000,000 men can perform in twenty years.

The workings of the human heart have been computed by a celebrated physiologist, and he has demonstrated that it is equal to the lifting of 120 tons in twenty-four hours. Presuming that the blood is thrown out of the heart at each pulsation in the proportion of sixty-nine strokes per minute, and at the assumed force of 9 feet, the mileage of the blood through the body might be taken at 207 yards per minute, seven miles per hour, 168 miles per day, 61,320 miles per year, or 5,150,880 miles in a life-time of eighty-four years. In the same period of time the heart must beat 2,869,776,000 times.

Sulphur, or brimstone, is a yellow, solid element; we know it in fine yellow powder, flour of sulphur, and in sticks or rolls. If we heat a little bit of sulphur in a spoon over a flame, it first melts, then boils, and then takes fire and burns away entirely, giving off a pale blue flame, having the well-known smell of burning sulphur. Phosphorus is an element which does not occur in the free state in nature, but is contained in the bones of animals in combination with oxygen, and the metal calcium, forming calcium phosphate. When a bone is burnt, a white porous mass is left, called bone-ash, and from this phosphorus can be prepared.

Birds do not eat fire-flies; and even bats, which seem to eat everything else that they can chew or swallow, never touch them. There must be something distasteful in this insect to the feathered world, and thus the species is preserved, for if it were not so, fire-flies would soon become extinct, as the torch they carry would only serve the purpose of attracting their enemies. It may be that the uncanny appearance of the insect, giving forth, as it does, a brilliant flash of light every moment or two, deters birds and bats from attacking it, but if it were a toothsome morsel to a bird's bill, any number of the feathered world would soon overcome their repugnance of the little living torch, and go hunting for fire-flies.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 37.

145.—How is electrical radiation produced ?

It is produced by the oscillations of a state of etherial strain—by what may be more simply described as shaking the ether to and fro. Perhaps the simplest method of generating electric rays is to permit a Leyden jar to discharge itself between two conductors placed very near to one another. The jar is instantly discharged in great part by the first spark that passes. In fact, just as a bent spring suddenly released will overleap its mean position, so the electrostatic charge in the jar overreaches the condition of neutrality, and gives rise to secondary charges of reversed sign on the two coatings. This more than discharged condition of the jar, or, in other words, this reversed charge, gives rise to a flow of the electricities back again into the first position, and so on—the oscillations of the electrified or strained ether taking place with very great rapidity (that can be calculated from the dimensions of the jar) and gradually decreasing in amplitude or dying out. This dampening of the oscillations is due in part to local heating, *and* in part to the production of electrical radiation thrown off in every direction from the spark or centre of etherial disturbance with the speed of light. In fact, everyone who has amused himself by drawing sparks from Leyden jars has been unconsciously producing radiant electricity.

146.—Why does the intensity of light decrease as the square of the distance traversed ?

In free ether the intensity of a parallel beam of light would be nearly constant, the loss of energy due to friction in the ether itself being inappreciable. But when the light emanates from a point, and travels in every direction with equal freedom, then it is necessitated by the law of conservation of energy that the power of the light over any uniformly lighted surface must be inversely proportional to the area of that surface. Light travels in straight lines, and, therefore, to everyone who has read the first book of Euclid, it will be evident that the area lighted up by any given bundle of rays must vary directly with the square of the distance. These explanations prove the law that the *power* of the light varies inversely with the square of the distance. But the fact that visual action is strictly proportional to the intrinsic energy of light undulations, and that this, therefore, varies also in a similar manner with the distance of the source of illumination, can only be accepted as being warranted by experiment.

147.—What is the most rational supposition regarding the condition of matter at the centre of the earth ?

It is probably an intensely viscous fluid, that is to say, a fluid which would behave under the application of any ordinary stress like a solid body of extremely great strength.

148.—What is the difference between a gas at very high pressure and the same gas liquified by cold ?

A gas under intensely high pressure, but above what is called the "critical temperature," may pass into the liquid state by reduction of the temperature below that critical point, without giving any optical indication of the change that has taken place. This very expansible liquid can only be distinguished from the gas by its capacity to form a free surface. In assuming a definite bulk bounded by such a free surface, it is the mutual attractions of the molecules that have asserted themselves. The effect of rise of temperature is to increase the force of the intermolecular collisions, thus overcoming the mutually attractive forces. And the gas is distinguished from the liquid by the speed of the internal motions—not necessarily by any difference of density.

149.—What is calorescence, and how is it produced ?

Calorescence is the name given to a method of producing light from the invisible rays of dark heat. These rays, which may, so far as the theory of the matter is concerned, be those emitted by a kettle of hot water, are concentrated to a focus by a lens or mirror. And in the focus is placed a small piece of solid matter which becomes so rapidly heated that it turns white hot, that is to say, it emits light. Practically the rate at which heat is evolved by a kettle of hot water is too slow for the exhibition of the phenomenon on an appreciable scale. It is usual to employ a convergent beam of radiation from an electric arc lamp. A cell containing solution of iodine in bisulphide of carbon is placed in the path of the beam, and serves to cut off absolutely all of the luminous rays, while permitting those of dark heat, required for the experiment, to pass freely.

150.—What is protoplasm ?

Protoplasm is the substance which Huxley styled the physical basis of life ; that is, it is the material, the molecular changes in which result in the phenomena which we regard as characteristic of living matter. Its composition when alive is unknown, but it is certain that it is extremely complex, and is in a state of continual change—now being built up into unstable compounds, and again breaking down into bodies of simpler composition, liberating in such changes energy which appears in the form of animal heat, mechanical work, etc. When living matter dies, there is invariably found a substance known as proteid, which may be regarded as approximating in composition to the living protoplasm. This proteid belongs to the class of bodies called colloid. It contains about 53% of carbon, 17% of nitrogen, 7% of hydrogen, 23% of oxygen, and a little sulphur. The exact chemical constitution of this body has never been satisfactorily determined.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest ; and those selected will be published in the issue after next.

157.—What is the so called blind spot in the eye and how can its presence be demonstrated ?

158.—What is the best method of diciphering the inscriptions on old worn coins ?

159.—How do conjurors produce the effect of fiery sparks issuing from the mouth ?

160.—Is it a fact that temporary madness results from eating black henbane ?

161.—What is the meaning now attached by scientific men to the word elasticity ?

162.—What explanation can be given of the fact that the eyes in painted portraits sometimes appear to follow the movements of an observer ?

HUMAN FLIGHT RIDICULED.

From a physiological point of view, man seems to be pretty well fitted to get through this world by walking, and, says a lay contemporary, to be but poorly adapted to imitate the mode of locomotion of either the fish or the bird, not having fins or gills like the one, nor wings and feathers like the other. And yet, since he is monarch of all he surveys, it should not seem strange if he attempted to rival them, even in their own specialities. No doubt he early acquired the art of swimming; and we know that there are to-day savage tribes who are about as much at home in the water as on the dry land, and who attack the ferocious shark, hand-to-hand, even on his own chosen field of battle. Yet, in a fair swimming contest, nobody would for an instant refuse the first prize to the shark. If man's physical build renders him ill-adapted to play the part of the fish, he would evidently make a still more unlikely bird. In swimming his whole weight is sustained by the buoyancy of the water, and he has need of muscular effort merely to keep himself right end up, and to propel himself onward. On the other hand, the air supports but a very small fraction of his weight, in fact, less than four ounces for a man of medium size, so that, if he would fly, he must raise practically his whole weight, and this with no more solid support than the air itself.

The problem looks hopeless, and yet, from the very earliest times, even down to our own days, man has coveted the mastery of the air as well as that of the waters. According to Suetonius, Simon Magus, in the time of Nero. attempted to fly from the roof of one house to another, but failed in the attempt, and was killed by the fall. There is no intrinsic impossibility in this, and so we let it pass. Again, during the Middle Ages, many attempts were made at flying by means of artificial wings, but they all seem to have ended in disaster. The only case with which we are acquainted, which was a decided success every time, was Mother Goose's Old Lady, who used regularly to go up on a broom and sweep the cobwebs from the sky. But, alas! the modern scientist refuses to believe even this.

Seriously speaking, we are fully convinced that man, as we know him, is not able, and never will be able, to fly by purely muscular effort, no matter how many wings and feathers he may take unto himself. Birds do it, but, weight for weight, birds are many times stronger than the strongest men. Notwithstanding this, a certain number of men have been discussing for years past, in scientific journals, the mechanism of the flight of birds, with the ultimate end of learning to fly themselves. Each one of them, our contemporary continues, is perfectly sure in his own mind that he knows all about it; but we modestly confess that we understand none of them, and never hope to. Albert of Saxony, a monk of the order of St. Augustine, thought that, as fire, according to Aristotle, is more attenuated than air, and floats about our atmosphere, if a light hollow globe were filled with that substance, it would rise to a certain height and remain suspended. Caspar Scott, a Jesuit, adopted substantially the same speculation, only he proposed to replace the fire by the thin, distant, ethereal blueness which he believed floated above the air. He never succeeded in laying in a stock of this useful substance, and the project failed in consequence.

Again, it was believed that the dew was of celestial origin, being shed by the stars, and that it was drawn up to heaven in the course of the day by the heat of the sun. Hence it was thought that hen's eggs, filled with morning dew and exposed to the heat of the sun would ascend to the sky, and, at nightfall, descend to the earth. So, with a sufficient number of these and a suitable car, a man could dine above the clouds and return to earth for supper. We do not find that it ever occurred to the people of those days that it would be just as well to drink the morning dew and dispense with both car and egg shells! Neither can we find out why hen's eggs in particular were chosen at a time when geese were so abundant, This will probably ever remain a blank among the pages of history.

Another scheme similar to that of Father Scott, but a little more definite, was put forward as late as 1775 by Joseph Galien, a Dominican. He was a professor of philosophy and theology at Avignon, and spent his spare moments in dreaming about flying machines. He wanted to collect, not the fire nor the ether, but the thin air of the upper regions, and inclose it in a vessel extending more than a mile every way, and intended to carry fifty-four times as much weight as did Noah's Ark. Truly, this was a grand idea, vast, majestic, chimerical. Somewhat better than these, because it contained at least one true principle, was the suggestion of Francis Lana, a Jesuit, whose works were published at Bresica in 1670. Torricelli, in 1643, had shown how a vaccuum might be produced by means of mercury or water in tubes, and Lana, taking the hint, reasoned that since there is nothing lighter than nothingness, a light vessel filled with that would have a great ascensional force. He therefore planned a machine after the following fashion: Make four hollow balls of copper 25 feet in diameter and 1-225th of an inch in thickness. Attach them by vertical rods above the corners of a basket about 75 feet square, and then exhaust them of air by Torricelli's method. A mast carrying a spare sail is to be planted in the middle of the basket. Lana made all his calculations very nicely, whence it resulted that the ascensional force of the four balls together would be from 1,100 to 1,200 pounds. This would be quite enough to raise the basket, sail, and several passengers. The plan never got beyond the paper on which it was described. Its weak point was in this, that when exhausted of air each ball would have to sustain an atmospheric pressure, tending to crush it, of over 2,000 tons.

KNOWLEDGE OF NATURE.

Any man who should attempt to live in a country without reference to the laws of that country would very soon find himself in trouble. In like manner, anyone who tries to live upon the face of this earth without attention to the laws of Nature will live there for but a very short time, most of which will be passed in exceeding discomfort; a peculiarity of natural laws, as distinguished from those of human enactment, being that they take effect without summons or prosecution. In fact, nobody could live half a day unless he attended to some of the laws of Nature; and thousands of us are dying daily, or living miserably, because men have not yet been sufficiently zealous to learn the code of Nature.

"Cool as a cumber" is correct scientifically. Investigators claim that that vegetable usually has a temperature one degree less than the surrounding atmosphere.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

WHAT TO EAT IN HOT WEATHER.

Few people adapt their diet to any particular season of the year or its temperature. The ordinary individual eats the same breakfast, lunch, and dinner in spring, summer, autumn, and winter—the same routine of bread, meat, puddings—and the majority of the more wealthy classes consume almost identically the same food, only, perhaps, more delicately manipulated in our time by culinary art. It does not seem to enter into the calculations of the middle-class cook, or the aristocratic *chef*, that there is such a thing as the physiology of dieteties. His aim seems to be to furnish a substantial or delicate meal, pleasant to the palate, utterly regardless of the dietetic value of its constituents, and whether they are more particularly adapted to hot or cold weather. Eating is considered by many, whose intellectual attainments ought to teach them better, almost a religious duty—an irksome one, it is true, as some would say, but one that necessity compels them to perform. In the opinion of Dr. N. E. Yorke Davies the well-known specialist for obesity, from whose recent publication we have culled this article, the physiology of food should be taught the rising generation as an important item of school life. If this were so, what a vast difference it would make in the comfort, the health, and the well-being of the individual; and with what a reserve of strength he would, if properly nourished in early life, commence his struggle with the world, whether that struggle involved physical or mental work!

Half the illness that occurs at one season, Dr. Davies points out, is due to improper dieting taken at another. We hear of people feeling weak in the spring, or suffering from those different ailments due to malnutrition, such as boils, skin diseases, obesity, or debility. Now this would not be so if the person adapted his diet to his requirements and to the season. No sensible person would think of keeping a large fire burning in his room in the summer. If he did, he would undoubtedly soon feel the effect of it: but many a man who would feel himself insulted if he were not thought a sensible person, will eat in the summer to repletion foods the particle action of which is to supply heat in excess. The foods that are converted into heat—that is, keep up the heat of the body—are starches, sugar, and fat; and those that more particularly nourish the nervous and muscular system are the albumen and salts.

Dr. Davies assails the time-honoured belief that meat is a *heating* food—that is, in the sense of giving warmth, and raising the heat of the body; and that *farinaceous* foods are the *reverse*. People believe that the less meat they eat in the summer the better, "because it tends to heat the system." Now, it is a curious thing that in dieting people for the reduction of fat by dietetic means only, Dr. Davies is in the habit of cutting off farinaceous foods, sugar, and fat, and giving large quantities of meat, green vegetables, stewed fruit, and other non-fattening substances, in quantity regulated according to the height, weight, and physical or mental work of the individual, male or female, as the case may be; with the result that in the colder months of the year people tell him that they do not feel too warm, clothe as they will. To so great an extent does this sometimes occur, that he is obliged to supplement the non-fattening diet by giving a little heat-forming food, such as cream, or a slightly increased amount of bread, or a small quantity of fat. The result is at once apparent. The body warmth becomes more comfortable. Now, what does this show? It shows that the foods that supply heat are more particularly farinaceous foods, sugar, and fat; and this is admitted by all dieticians now. If this is so—and it undoubtedly is—it naturally stands to reason that when the external temperature performs this duty, the individual cannot require so much food that will, by its chemical decomposition in the body, maintain a high temperature, and, if taken, as is usually the case, in excess, become an incumbrance by being stored as fat.

With regard to the proper diet for hot weather, we must take into consideration the occupation of the individual. A man doing sedentary work or intellectual work would not require the same diet as a person doing laborious muscular work; but this article, in nine cases out of ten, would appeal to the ordinary individual earning his living by the sweat of his brow, or by the "sweat of his brain." If a man earns his living by the sweat of his brain he must, if he wishes to live long, maintain his health by the sweat of his brow, that is, he must, in some form or other, take muscular exercise. He may do it by brisk walking, tennis, bicycling, shooting, hunting, or the thousand and one pursuits that the average Englishman indulges in: so that the diet laid down as suitable for summer will, under these conditions, almost universally apply.

Nature apparently knows what is good for us, and Nature furnishes for the different seasons suitable substances in the way of food. But, of course, Nature assumes that man, being a reasonable being, should study and apply them as he ought to do; but Nature in this case credits man with attributes that in this matter he seldom possesses, or, at all events, does not care to use if he does possess them. Men do not study Nature as much as they should, at least the majority do not. If they did, they would see that in the warm weather fruit should form a considerable portion of the daily food. The most suitable articles for hot weather, are fish, such kinds of meat as fowls and game, green vegetables, salads, and fruit. Farinaceous food, that is, starches, should be taken in the very smallest quantity only. Sufficient sugar would be found in the different fruits that the season of the year produces, and, therefore, should not be supplemented.

In an article of this kind it would be perfectly impossible to distinctly draw a dietary suitable to each individual. This can only be done by taking into consideration the mode of life, the idiosyncrasies, the intellectual work, the peculiarities of constitution of a particular person; but in the case of the ordinary healthy person, of course, these distinctions are not necessary. If a man is too fat, he would require certain modifications; if he is gouty or biliously inclined, slight change would be necessary; but to go into this would be unnecessary and out of place, and every intelligent person must alter and adapt the dietary to his means and to his special requirements. In the case of a man of ordinary size doing ordinary physical or mental work, this would represent an ordinary day's food for hot weather, as far as quantity and constituents are concerned:

BREAKFAST, 8.30 to 9 A.M.—Two cups of tea or coffee, sweetened with saccharine, one or two teaspoonfuls of cream in each; 1 oz. of dry toast, thinly buttered; 4 ozs. of grilled or boiled fish, such as plaice, sole, whiting, haddock, cod, or trout, or 4 ozs. of cold chicken, cold tongue, or of grilled steak or chop

LUNCH, 1.30 P.M.—Two or three ounces of cold mutton, beef or lamb; 3 or 4 ozs of green vegetables, plainly boiled, plenty of green salad, made with vinegar, but without oil; 4 or 5 ozs. of stewed fruit; water, or 2 or 3 glasses of pure dry Moselle or other Rhine wines.

AFTERNOON TEA, 4.30., IF DESIRED.—Two cups of tea as at breakfast; nothing to eat.

DINNER, 7 to 8.—Julienne, or clear vegetable soup; 3 or 4 ozs. of fish; 3 or 4 ozs. of any *red meat*, or of chicken, rabbit, game, or venison; 6 ozs. of any green vegetable, with gravy from the meat

only; 4 ozs. of stewed fruit or of raw fruit; a little stale or pulled bread, and a small piece of cheese.

This diet may be varied as to hour; but three meals only should be taken daily, and only sufficient at each meal to satisfy appetite. Fruit may be taken at other times, and any quantity of fluid, so long as it does not contain sugar.

Fruit is only beneficial in moderate quantity. If taken in excess, and out of proportion to other food, it is apt to derange the bowels and cause diarrhœa; more particularly is this the case if it is eaten underripe or overripe—in the former case, from its undue acidity; and in the latter, from its strong tendency to ferment and decompose in the digestive tract. Fruit diminishes the acidity of the secretion of the kidneys, and by virtue of this is advantageous in gout.

It goes without saying that more fluid is necessary in hot weather than in cold. Indeed, so long as it is a harmless fluid, Dr. Davies questions whether too much can be taken. Fluid in this way is to the kidneys what fresh air is to the lungs, and the waste of meat not used in the system is carried off by its aid.

A meat diet is healthy and life-prolonging if supplemented with plenty of fluid to carry off its waste. That fluid should be taken in large quantities in the summer is a wise provision of Nature, as the skin carries off a large amount of waste from the system, and therefore its activity should be stimulated in every way, and it is most desirable by frequent baths to keep the pores open. The perspiration drying on the skin leaves a deposit of its salts and other waste constituents, and these should be washed off as a matter of health.

It would be no use advising those who take stimulants for the sake of their stimulating qualities, that spirits and beers, and certain wines, are too heating in the summer; and that, however suitable port, sherry, spirits, and beer may be in the colder months of the year, the most suitable beverages containing alcohol, for this reason, are those known as the light, dry Moselle wines. Even claret and Burgundy contain a large quantity of tannin, and taken in excess are, therefore, apt to disagree and derange the stomach. Where a nice dry Moselle is drunk in fairly moderate quantity no harm can accrue. Of course, the quantity that would apply to one person does not apply to another, and a free drinker would certainly not be satisfied with less than two bottles.

The man who lives to eat, drinks after his soup a glass of pale sherry; after his fish, Rhine wine: with his joint, Burgundy and champagne; with the *entrées*, Bordeaux or Burgundy; with the ice, champagne or liqueur, and with his dessert probably some old crusted port. But the man who eats to live would be satisfied with one pint of dry and delicate white wine, to cover the whole of this *menu*.

It is a well-known physiological fact that the system can not assimilate more alcohol than is contained in a pint of dry Moselle or claret, or in a half-pint of sherry or three pints and a half of table beer, supposing it to be in that form, or if taken in the form of whisky, about a wineglassful of pure whisky per day. Dr. Davies does not say that an excess of any of these quantities would be absolutely injurious to health, and many might and do exceed them considerably for very many years with impunity: but still, in ordinary individuals, this is the quantity that can be taken with no harm whatever.

There can be no doubt that the most refreshing beverage in summer, and certainly the most harmless, is the properly made cup of tea, but alas! how seldom does the ordinary English household in England get a properly made cup of tea or coffee! The first cup may be by chance drinkable, or it may have infused half an hour, and therefore contain all the tannin and other disagreeable and injurious products of the leaf. In the summer time it should be sweetened with saccharine instead of sugar, and flavoured with a little cream. Some prefer tea with a squeeze of lemon-juice in it, and in this way it is possibly more wholesome and suitable as a cooling beverage.

It is astonishing what a complete change in diet will do. Change in the diet acts like change in the air, and is a potent factor in the treatment of those conditions that indicate exhaustion of the nervous system, and, as a corollary, general collapse. When the diet is properly regulated for the different seasons of the year in regard to its constituents, there is seldom any necessity to take what some people are so fond of doing, that is, purgative medicines in the spring and in the autumn. A little alkaline aperient may be taken at any season with benefit by people who live well and who are of sedentary habits, but beyond this it is a mistake to take irritating and powerful purgatives during the early spring and summer, as they are sure to set up diarrhœa that may go on for some time, especially if unreasonable quantities of fruit be indulged in.

To maintain life at its highest standard and for the longest period should be the aim of every individual, and this can only be done by adapting our food to the requirements of the system and the time of the year. If the body is properly nourished, disease will not attack it; and if it does, will get no foothold. It is like an impregnable fortress—it may be assaulted, but it cannot be taken. But to get the economy into this state of perfection, it must be remembered that no more food should be taken than will be consumed in the operations of life, and no more stimulant than the amount previously indicated, so that no surplus of either shall remain in the body in the shape of excess of fat, or as waste, in the form of gout poison or acidity. "Gluttony," says an old writer, "kills more than the sword." On the other hand, there is no reason why food should not be made as palatable as possible—in fact, the more palatable it is the better. It is not excess in variety of food that is injurious, but excess in quantity.

NO SUCH THING AS CHANCE.

A peasant imagines that the hail which has fallen in his ground is purely matter of chance: but the philosopher knows that there is no such thing as chance; and that by the constitution of the world it must necessarily have hailed that day in that very place. Some, alarmed at this truth, say there are necessary events, and others which are not so. But it would be odd indeed, that one part of this world were fixed, and not the other—that some things which happen were to happen, and that others which happen were not necessarily to happen. On a close examination, the doctrine which opposes that of destiny must appear loaded with absurdities, and contrary to the idea of an eternal Providence. *But many are destined to reason wrongly, others not to reason at all, and others to persecute those who do reason.*

VOLTAIRE.

THE perpendicularity of a tall monument is affected by the rays of the sun. It leans away from that luminary, owing to the expansion of the side on which the rays fall.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

THE FORCES OF NATURE.

A most interesting paper was read before the Liverpool Engineering Society at a recent meeting, by Mr. W. H. Preece, F.R.S., on "The Utilisation of the Waste Forces of Nature."

The lecturer explained that the sun is the *fons et origo* of all the available energy upon the surface of our earth. Countless ages ago its warm and vivifying rays promoted the growth of plants and ferns and trees, which, falling where they grew, formed those great beds of coal now being brought to the surface, and which, combining with the oxygen of the air, provide us with heat and power to supply our wants, to maintain our manufactures, and to expedite our locomotion. These same rays are now in a similar way hastening the growth of trees and making wood, the difference between wood and coal as fuel being only age. They are now also furthering the annual growth of grasses, corn, fruits, and vegetables, to become food for beast and for man, and to supply them with fuel to maintain their life, their strength, and capacity for work. The same rays playing on the surface of the waters promote the evaporation of the liquid into gas, which, mixing invisibly with the air, gives evidence of its presence when the lowering of temperature causes its condensation into the floating clouds, and its ultimate return into the waters in the form of the gentle rain, the rippling brook, the roaring torrent, or the flowing river. The sun's rays, again, produce that variation of temperature in our atmosphere leading to currents of air which sometimes fan our faces with cool and refreshing breezes, and at other times rage and roar with the relentless fury of a tornado. The sun, together with the moon, so attracts the mobile waters of the ocean that it produces great periodic waves and currents known as the tide, which ebbs and flows with such uniformity and regularity that we can calculate the rise and fall of the water at any particular spot, and its rate of flow, not only at the present day, but for any future time, provided that the geographical conformation of the land and the bottom of the sea remain unaltered.

Coal and oil pent up in the bowels of the earth and water accumulated in the higher levels of the land are our great stores of energy, available for the wants and purposes of man. The wind, the running streams, and the flowing tide are the passing forms ef energy which are available for our present use, while food is the particular form of fuel which maintains life and provides the means of doing work. These are all natural sources of energy; while gunpowder, gas, compressed air, steam, chemical affinity, etc., are artificial sources which the ingenuity of man has fashioned for his use.

In that interesting work of Smiles, "The Story of the Life of George Stephenson," we read: "One Sunday, when the party had just returned from church, they were standing together on the terrace near the hall, and observed in the distance a railway train flashing along, throwing behind it a long line of white steam. 'Now, Buckland,' said Mr. Stephenson, 'I have a poser for you; can you tell me the power that is driving that train?' 'Well,' said the other, 'I suppose it is one of your big engines.' But what drives the engine?' 'Oh, very likely a canny Newcastle driver.' 'What do you say to the light of the sun?' 'How can that be?' asked the doctor. 'It is nothing else,' said the engineer; 'it is light bottled up in the earth for tens of thousands of years—light, absorbed by plants and vegetables, being necessary for the condensation of carbon during the process of their growth, if it be not carbon in another form; and now, after being buried in the earth for long ages in fields of coal, that latent light is again brought forth and liberated, made to work, as in that locomotive, for great human purposes.' The idea was certainly a most striking and original one; like a flash of light it illuminated, in an instant, an entire field of science."

I have used the words, *work*, *energy*, *power*. *Work* is the effort exerted when we overcome resistance. When we walk upstairs we overcome the resistance due to the attraction of the earth, and we raise our bodies to a higher level. Work is thus done by ourselves on ourselves. When a train is moved from Liverpool to Warrington, the friction or resistance of the rails is overcome as well as that due to gravity (for we go up hill). Work is thus done by the locomotive on the train of carriages. Force has been applied, resistance has been overcome through a certain distance, and this is the measure of work expended. But this capacity for doing work must exist in a dormant state both in our bodies and in the locomotive, and this is called *energy*, which is stored up in food and in fuel, energy being simply the capacity for doing work. While the work done or energy expended is measured by the distance through which resistance has been overcome and by the weight of the object moved, the *rate* at which the *energy* is expended or the amount of work done per minute or per second is the *power*.

Power is, therefore, the rate of doing work. Watt called the work expended in one minute in raising 33,000 lbs. ($14\frac{3}{4}$ tons) one foot high a *horse-power*, and this is the same as raising 550 lbs. per second. A man can raise $\frac{1}{2}$ cwt. per foot per second for a short time. A horse dragging a cart of materials weighing one ton over a level road at a speed of four miles an hour exerts this power; and one of Mr. Webb's locomotives driving an express train over the London and North-Western Railway at 60 miles an hour may expend about 750 horse-power. Fourteen gallons of water falling four feet per second could perform about the same work as this typical horse, and thus a horse-power becomes a very convenient though rough and unscientific measure of the rate of expending energy.

Energy is expended when coal or wood is burnt, when water falls, when tides flow, when the winds blow, when food is digested; and the function of steam and gas engines, of water wheels and turbines, of windmills and of beasts of burden, is to transmit this energy to some spot where it can be utilised for the wants and purposes of man. But water is ever falling in the mountains of Wales, shining rivers flow on for ever and for ever, the tides ebb and flow daily in our straits and estuaries, the wanton winds expend their energies always over the surface of the land; and man neglects these stores of energy that Nature gives him at his very door.

Let us assume that we have at our command, at one spot, some source of energy, such as a steam engine or a water turbine, how can we transmit the power exerted to some other spot where it can be better utilised? Belts and shafts and ropes are at our command. A 4 in. rope, moving at a speed of 2,000 ft. per minute, transmits 8 h.-p. The valleys of Switzerland abound with such conveniences. We may even lead the water itself in pipes and channels, and in America they even distribute the live steam over considerable areas. Gas is a very convenient medium for the distribution of actual energy, and, since the advent of the electric light, its use for this purpose has been very largely encouraged. In the United States it is found in a natural state underground, and it is being conveyed to distances of even 100 miles.

Compressed air is a very convenient medium for the transmission of energy. It is largely used in mines. In London

it is employed for the transmission of telegrams, and in Paris it is in successful work for postal work and for a large number of industrial pursuits. 10,000 h.-p. can be transmitted 20 miles in a 30in. pipe by air at 132·3 lb. pressure, with an efficiency of about 40 per cent., that is, about 60 per cent. of the original energy is wasted or lost in transit. The efficiency of a system is the ratio of the energy utilised to the energy expended. Thus to get 1,000 h.-p. at the end of pipe 20 miles long, we must expend 2,400 h.-p. at the beginning.

The common way of transporting energy is by cart, or by train, or by ship. Thus coal and wood are carried anywhere, but at a price. This also means an efficiency, for the cost to the consumer is much enhanced by the carriage of the material. Coal at the pit's mouth costs 6s.; in Liverpool it may cost 18s. per ton; its efficiency is thus 33 per cent. In London we have been paying 30s. per ton; the efficiency is, therefore, only 20 per cent. There is another mode of transmitting energy, and that is by the electric current. It is not my intention to occupy your time with a description of a dynamo. It must be known to most of you; electric exhibitions have made us familiar with the principal industrial electrical apparatus. The dynamo is an instrument designed to convert the mechanical energy of motion into the form of energy called electrical. The answer to the question, "What is electricity?" is now, "Principally coal, and sometimes water." Five pounds of coal consumed per hour in a furnace flashes 50 lbs. of water into steam. The steam in its reconversion to water transfers its energy to a moving mass of machinery, a part of which consists of copper rods forming a portion of an electric circuit. These rods rotate in a magnetic field where work is done on them, and where, in consequence, the mechanical energy of motion is converted into the molecular energy of electricity. The 5 lbs. of coal have produced $1\frac{1}{3}$ h.-p., or 1,000 watts in the circuit: in fact, a kilowatt is the scientific unit of power, and a kilowatt-hour is the Board of Trade unit of energy for the use of which the Electric Lighting Company of Liverpool is allowed to charge 8d.

A watt is the energy expended by an ampere when driven by a volt. It is equivalent to nearly $\frac{3}{4}$ (actually 0·737) of a foot pound. The ampere is the unit current, and the volt the unit electrical pressure. A 16-candle glow lamp requires 100 volts and 0·48 ampere to incandesce it into brilliance. It therefore absorbs 48 watts, and, consequently, 1 c.-p. is produced by 3 watts. Hence, a kilowatt-hour uniformly expended will give us 333 candles continuously, or it will maintain 21 such lamps alight. But this kilowatt of energy need not have given us light; it could have been converted into other forms of energy; it could be used for electro-metallurgical purposes; it could deposit copper; it could produce aluminium; it could break up salt solution into chlorine and caustic soda; it could silver our plate and gild our cups; it could be reconverted into mechanical energy by electric motors; and could again drive machinery, turning mangles, knife-cleaning machines, and ventilators in our dwellings, sewing machines in our shops, blowing organs in our churches, driving tramcars on our streets and trains on our railways. Again, it could give us heat, warming our rooms, heating our irons, and, as we see every day in the Crystal Palace, boiling our water and cooking our food.

(*To be concluded next week.*)

The speed of the fastest railway is not much more than half that of the golden eagle's flight. The bird often makes 140 miles an hour.

THE PERPETUAL MOTION CONTROVERSY.

We have received another communication on this subject from H. O. Ward, who writing on behalf of Prof. Dewar remarks:—"An article in your number of June 4th on 'The Keely Motor' closes with the hope that Prof. Dewar's proposed visit to Keely's workshop may result in proving or disproving the possibility of 'perpetual motion.' As 'perpetual motion' is mathematically and physically impossible, such a statement as you have made is an injustice to Prof. Dewar. This learned professor, whose leisure hours are now engrossed with researches which he has been led to make by his recent wonderful discovery of the magnetic properties in liquid oxygen, would not even dream of wasting his time in examining the claim of 'a perpetual motion crank.' Equal injustice is done to Mr. Keely in having led your readers to think that he puts forward claims which are against nature, working as he is solely in conformance with Nature's laws. As Keely has spoken for himself on this subject in *The Scientific Arena*, if you are a lover of truth and justice you will be glad to publish this letter in your columns with his contradiction of the erroneous statement made in your columns of May 14th, and repeated June 4th.

"But if you are unable to find room, in this matter, as in all others, 'truth can afford to wait.' Prof. Dewar has postponed his visit to America until next year, when he will go to Chicago as a member of the Royal Commission, and on his return to London he will then have it in his power to report what he has seen in Keely's laboratory. As has been said in 'Keely's Progress,' published by the T. P. S.:—'Until the instruction has been given, which will put it in the power of the successor of Tyndall and Faraday to make known the importance of Keely's discoveries to science, Keely must continue to bear the abuse of the prejudiced and the misinformed.' Still, as scientific accuracy requires a correction of the mis-statements, I shall hope to see this letter in print."

Our esteemed correspondent incloses the following, written by Mr. John W. Keely for *The Scientific Arena* of December, 1886:—". . . I shall not foretell an unproved conclusion, but fight step by step the dark paths I am exploring, knowing that should I succeed in proving one single fact in science heretofore unknown, I shall in so doing be rewarded in the highest degree. In whatever direction the human mind travels, it comes quickly to a boundary line which it cannot pass. There is a knowable field of research bordered by an unknown tract. My experience teaches me how narrow is the strip of territory which belongs to the knowable, how very small the portion which has been traversed and taken possession of. The further we traverse this unknown territory the stronger will become our faith in the immovable order of the world, for at each advancing step we find fresh fruits of the immutable laws that reign over all things, from the falling apple up to the thoughts, the words, the deeds, the will of man; and we find these laws irreversible and eternal, order and method reigning throughout the universe. Some details of this universal method have been worked up, and we know them by the names of gravitation, chemical affinity, nerve power, etc. These material certainties are as sacred as moral certainties. . . . . The nearest approach to a certainty is made through harmony with Nature's laws. The surest mediums are those which Nature has laid out in her wonderful workings. The man who deviates from these paths will suffer the penalty of a defeat, as is seen in the record of perpetual motion seekers. I have been classed with such dreamers, but I find consolation in the thought that it is only by those men who

utterly ignorant of the great and marvellous truths which I have devoted my life to demonstrate and to bring within reach of all."

[We have much pleasure in publishing this interesting letter, and in assenting fully to the writer's views as to the improbability of perpetual motion ever being attained. It is, perhaps, a little beyond the mark to say that the impossibility of creating motion has been *mathematically* demonstrated. All experience is, however, arrayed against this *ignis fatuus* by which so many inventors and too-confiding capitalists have been led astray. It is gratifying to be informed that Mr. Keely intends devoting himself to the *demonstration*, rather than the mere assertion, of technical propositions. We cannot forget, however, that the shareholders in the original Keely Motor Company (whether with or without the assent of Mr. Keely himself) most undoubtedly paid down their money for the prospective patent rights in what promised to be a system of nothing less than the generation of practically unlimited power.—Ed.]

COMMUNICATION WITH MARS.

An intelligent suggestion has been thrown out for exchanging signals with the inhabitants of the planet Mars, if any such there be. It is that a perfectly level area, say at least five miles in diameter, not in the vicinity of hills or mountains, be covered with a uniformly black coating of earthy sand or coal dust. This area is to be covered with gas jets or electric arcs, placing the illuminating points about three feet apart. That would require some 6,000,000 points of intense brilliancy, visible to the inhabitants of Mars, with a magnifying power of 300 diameters when the earth was sufficiently far away from conjunction to be seen while the sun was below the belt of twilight.

The plan is to so construct and connect these signal lights that the turning of a key would instantly extinguish or light them all. Then the illumination should be made o appear and disappear at regular intervals. Suppose, at first, the interval between the flashes was three seconds and the flashes continued five seconds. Then the intervals and duration of light should be changed, say, to six, twelve, eighteen, &c., seconds, and then the series of intervals reversed. It is argued that such signals would hardly be kept up long without attracting attention on Mars, if its inhabitants be far advanced in intelligence, development, and civilisation. They must then conclude that the earth is similarly inhabited, and that some of its people had constructed a flash-light visible to dwellers on Mars. It also may be expected that they would arrive at the conclusion that such light was maintained as a signal to attract their attention. Further, it may be supposed that in the latter case they would make arrangements to return the signal, if possible, though some, perhaps many, years might elapse before they could respond in a manner we should understand.

This is a pretty theory, and its author deserves credit for having been the first to show the world how interplanetary communication is possible. But there still remains the question, Is it practicable? For the present, at least, that must be answered with a decided negative. It is not likely that any man, or association of men, would undertake the enormous expense involved in carrying out this scheme, seeing that there is in it no suspicion of profit, and but a problematical amount of glory, not to be gained till perhaps years after the death of the investor. If a generation should ever arise on this earth that loves wisdom more than wealth, it may find other uses for its money than in trying to bridge the gulf that separates us from the other members of the solar system; but till then it is idle to expect the costly effort to be made. Still it would do no harm for the enthusiastic ones to revel in anticipation of some such result to be achieved by those who will come after them, and there is another view of the case still more enticing to those who are speculatively inclined.

Some of the philosophers who have studied the appearance of Mars think there is reason to suppose its inhabitants are much further advanced than ourselves in the march of intellectual progress, that planet having cooled down from the original nebulous heat sooner than its larger brother or sister, the earth. Hence it is not absurd to suppose the inhabitants of Mars already have been considering the problem of intercommunication with other members of the solar system, and for ought we know they may have been making such signals to us for centuries past without our being aware of the fact. If some of the lynx-eyed ones who scan the objects in the sky through telluric telescopes once see changes on the surface of Mars which they fancy indicate that signals are in progress, the case would be radically altered. It might not then be impossible to find persons willing to stand the immense cost of setting up and conducting a return telegraph apparatus, by means of which we may acknowledge the salute and raise ourselves in the estimation of our neighbours.

A BOY'S INVENTION.

Humphrey Potter is probably the only boy who ever invented anything of practical use to the world. Before Watt had perfected his discovery the Newcomen engine was considered the best. Besides a man, it required the services of a boy to turn alternately the two cocks, one admitting the steam into the cylinder, the other admitting the jet of cold water to condense it. This work was easy enough, but it soon grew monotonous, as it had to be constantly attended to. Potter was lazy, and he thought how much time he would have for play if he could only make the cocks turn themselves. He observed the alternate ascent and descent of the beam above his head, and, being a bright boy, he thought he could save himself much work by applying the movement to the alternate rising and lowering of the levers which governed the cocks. He contrived a device, which he called the "scoggan" (meaning lazy boy), consisting of a catch worked by strings from the beam of the engine. While the arrangement was, of course, very rude, it not only answered the purpose and made the engine automatic, but improved the working power by increasing the number of strokes from 6 to 15 in the minute. Henry Beighton, who added the plug-rod and hand-gear, subsequently improved upon the boy's work by doing away with the catches and strings and substituting a rod suspended from the beam, which alternately opened and shut the tappets attached to the steam and injection cocks.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.
Or from Messrs. W. H. Smith & Son,
and through any Newsagent.

AN INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. I, price 1s., post free, 1s. 2d.

SOCIAL SCIENCE.

THE COMING WOMAN.

A good deal has been said of late about the sphere and capacity of woman, but a good deal more has been done by woman and circumstances to determine what her own power and place are. It cannot but be satisfactory to the most conservative that woman has a wider life than formerly, and a much more certain chance for self-culture and self-support. The substitution of literary, scientific, and social topics for the petty affairs of local gossip and village intrigue cannot but be beneficial as a natural consequence of the revolution in higher education. It may not seem to so large a number a matter to be rejoiced over that woman has entered the professions and trades, and that she has won her place of honour as a wage-earner and manager of large enterprises. The gradual approximation to equality of the sexes seems, however, to be something like the problem of perfection—it can always be approached and never quite completed. Better, perhaps, to say that with all our removals of obstructions to the unhindered improvement of woman there remain certain fixed characteristics that keep the two sexes apart in work and duty. To define the differences will be a matter of more or less discord for some while yet.

It is an old story that some one must yet write out—the history of legal suppression of the sex. An autocratic Empress in 1750 made a law that at parties "ladies must not get drunk under any pretext whatever, and gentlemen not before 9 o'clock." Here was the unjust discrimination that permitted a man to be a gentleman when he was a beast, and drunk every night at 9 o'clock; but a woman must keep sober to put him to bed. This discrimination held on down through all branches of Aryan peoples. To this day, after dinner English ladies are expected to retire and allow the gentlemen to smoke and indulge in conversation that is not always to their credit. Literature has a similar tinge of distinction. There are books that men are allowed to read, but women would be considered debased if found perusing them. That is, there has been, and still is, need of equalising both ways; men have been, and still must be, allowed to become like women, as well as women have more of the privileges of men. The ideal social state will repeat the word gentleman with a new emphasis, insisting that the model man shall have no indelicate or indecent habits; none, in fact, that would disgrace a woman; while the woman will be allowed to get drunk just as early and just as often as her partner; that is, never at all.

No social fact is more evident than the changed relationship of the sexes, and the enlarged sphere of woman's rights, work and thought. These three items go together, for, while the claim for rights is more noisy, that for work and intellectual and moral enlargement is more real, or covered under the term rights as used by wise women and men. The natural position of the female in primitive society was absolute subjection and servitude. Such a relation could not be changed in hunting or pastoral races; in agricultural races the advent of a permanent home decreed the ultimate equality of the sexes—equality on a high plane of aspiration and achievement. This equality, however, is crudely misunderstood as yet as a process toward the merging of all offices and duties.

On the contrary, the divergence or differentiation of the sexes, in personality and in fitness, is increasing. Man is no more able to do woman's work, or woman man's work, than ten thousand years ago, nor as well able. This divergence of the sexes is physical as well as intellectual and moral. For instance, it is well known that primeval human beings were covered with hair. The wilder tribes are so covered yet. The Ainos frequently have their whole bodies clothed with fur 2 or 3 inches long. Our children before birth pass through this hairy stage of development. But later civilisation has crowded back that period, leaving the body after birth with only a good hirsute head-covering. Here comes our physical parting of the sexes; for while woman retains, and seems destined to retain, her luxuriant growth of hair, man is tending in all lands towards baldness.

To discuss the causes are unnecessary. Whatever they are, they are incidents of civilised methods of life. Man is destined to be bald; woman will, at least for a long time, retain her natural head-dress. It seems almost certain that man is to become the hairless partner. So far as the teeth are concerned the two sexes are walking more evenly together. Both are destined to a farther narrowing of the jaw; and the teeth, already four less than those possessed by primitive man, will soon be fewer still by two. This process may go still further; and our habits of eating will then conform still farther to the necessities of the case. There is nothing dreary in this forecast, as the women will probably consider man handsome then, not for his fine teeth, but for his toothlessness. Illustrations of a physical sort might easily be multiplied to the same purport. Intellectually also the sexes not only retain the same special biases possessed by our ancestors, but these mental divergences are increasing. A woman cannot see the world from the same angle of vision as a man, because of her sex instincts. These instincts are intensifying.

At present domesticated women may be roughly divided into "ladies" and "workers," but we are being taught by the apostles of science to save ourselves from drudgery. It is the nineteenth century appendix to the gospel of humanity and hope. Electricity, for instance will make, in time, the labour of heating and lighting our houses very much less than now. We are wasting probably nine-tenths of human power as well as material. With this relief from the absolute merging of self in household cares will come, as a matter of necessity, an enlargement of woman's sphere of social life. There will be less and less reason why she should not be engaged in the professions, trades and the productive employments. It seems more than probable that women will fill a very large share of the pulpits and possibly perform the work of gentle comforting spiritually. The sisters of mercy and charity can do and long have done for the sick and dying what almost no man ever could do. The masculine temperament can, but it seldom does, fit itself to the work of soothing pains and fears. As we need less to be preached, at, and as the press crowds closely on the office of the orator, the ministerial function will be more and more what the word implies—to minister. It will hardly appear to us, by and by, that woman has done any more than resumed her natural functions when she becomes the ministering force.

As for medicine, facts are speaking for themselves. Great universities are few that have not indorsed the view that woman is naturally assigned to the bedside of sufferers. That there are no Portias now as wise and learned as in Shakespeare's time is not demonstrable. In our law courts we need the greatest revolution in refinement and delicacy and probity. Will woman be able to reverse the very underlying errors that in the name of law subvert justice?

So we shall find that man has been in possession of some arts, occupations, and professions that are properly

the property of the other sex. These he will be gently dispossessed of. The natural laws that regulate the supply and demand will turn over to woman the duties she can most graciously fill. This, if done suddenly, would be revolutionary and astounding; but it will be on the contrary evolutionary, and cause no disturbance. The advent of machinery aids and abets the changes. The woman farmer is now quite an easy possibility, for the scythe and hook have given way to horse-power mowing and reaping. It is not improbable that we shall see a few of the usurpations of man reversed. Originally, all dairy work was done by women; it is to be hoped that milking will once more fall into the hands of the more tidy and hygienic sex.

But how about the family? The first fear of a conservative mind is always lest the family be undergoing dissolution by the changes that call women forth into active and public lives. We cannot fail to see that all social readjustments involve danger. The present multiplicity of divorces means a struggle. It means that, so far, the modification of our institutions is much in the dark. We do not know why any change is needed. There is, in fact, a sort of social panic; one party crying that the family is being abolished; another arguing that it must be so modified as to become temporary instead of permanent. Those who advocate the temporary family, battle directly with evolution, and cannot show that the end of such a marriage can be anything but sensual, for a temporary flame of love abhors the permanent home and the baptism of offspring in the love of common purpose and self-denial. We know of no right that any such persons have to use the word love as a covering for mere temporary passion, or even for a tender affection which does not involve and is not essentially made of mutual self-denial and altruistic purpose. On the other hand, those are equally unphilosophical who refuse to allow any remedy for an abhorrent marriage. They undertake to perpetuate the impure as well as unjust.

Mr. Grant Allen, whom most of our readers know something about as a writer on daisies and butterflies and all sorts of pleasant scientific topics, in a semi-scientific way, has lately turned his attention to woman. He rightly does not like colleges, because "they stuff girls with Greek, and the rudiments of faith, and mathematics, till they are like Strasbourg geese, stuffed with Indian meal." He thinks the woman of the future will be so "emancipated" that she will find her model in George Eliot, and choose her husband according to temporary preferences. Of course, this is progress, in his judgment; but it looks to a common-sense eye very much like going back to the habits of the very lowest races of savages and to beasts. Trying to get rid of some disadvantages of monogamy, this plan drops out and loses every one of the advantages and humanities that have now come out of the family and home idea. We only instance this proposition of Mr. Allen's to answer that there is nothing in history to suggest that we are liable to outgrow the fundamental family idea; or that woman can find a larger sphere of good by losing the duties of maternal care and the benediction of a well-trained family.

But there is a delicious sense of satisfaction in being a reformer; and we must understand that reform involves experiment. That there shall be a thousand revolutionary experiments proposed in such an age as ours is needful as well as natural. But the fundamental fact at the base of the divorce and family question, and of marriage altogether, is a readjustment of the relation of the sexes, socially, educationally, and, hence, legally, a readjustment that began over 2,000 years ago, but had its first grand recognition in the sixteenth century and its culmination in the nineteenth. It means fully this; that woman, who was in the primitive family only property, is now in the fullest sense an independent equal, and so must be dealt with. Marriage and society in all its phases have henceforth to move on the recognition of husband and wife as possessed of exactly equal if distinctive rights to become the most complete individual possible.

A BRAINY ANT.

"I was lying on my back in the shade of a tree, one summer day, looking up listlessly into the trembling mazes of the branches," says a correspondent. "The lower branch of the tree was quite low, and presently I saw one of those little white caterpillars that let themselves down from the trees by silken threads. They spin as they descend, and reel up again if they take it into their heads to go back. This little fellow was humping along on the limb at a lively rate, when suddenly it stopped, and if a caterpillar can look scared, this one did. I soon discovered the cause. A black wood ant, half as big as the caterpillar, was coming full tilt on the limb toward the caterpillar, and had its eye on it.

"When the ant was within two inches of its apparently easy prey, the caterpillar dropped off the limb, and, releasing about two feet of its silken cable, hung far out of the reach of its expectant foe. The ant reached the spot where the caterpillar had been, and absolutely fumed, it was so mad at being foiled of its prey. It ran frantically to and fro, stopping every now and then to look down at the suspended caterpillar, which had curved its head upwards and placidly looked back at the ant in aggravating enjoyment of its furious disappointment.

"The ant at last cooled down, and commenced thinking. It turned the matter over a moment, and then evidently hit upon a plan of procedure. It started with a rush toward the trunk of the tree, and I saw it disappear as it hurried up another one.

"I awaited further developments with breathless interest, for, knowing ants as well as I did, I felt that the foiled ant had not given up the battle yet. I had not long to wait. I soon discovered the ant returning down the limb accompanied by two other ants that it had gone after in some other part of the tree. The one ant ran out again on the branch the caterpillar was hanging from, but the two others disappeared. The ant on the limb stopped at the place where the caterpillar's thread was fastened, and remained there calmly gazing down at the prey so far out of its reach. I began to wonder what had become of its two companions, but just then my eyes fell on them, both coming hurriedly down the trunk of the tree. They were big, glossy fellows, and I knew they meant business. They reached the ground, paused a moment to get their bearings, and then made their way through the grass and stopped directly beneath the suspended caterpillar. That was what the ant up the tree was waiting for. The two ants below had no sooner stopped than the ant above proceeded to carry out his part of the programme they had agreed upon. He reached over the side of the limb, nipped the caterpillar's cable in two, and before the poor worm knew what had happened to it, it had tumbled to the ground and was pounced upon by the two fierce ants below. By the time the ant in the tree had hurried down and joined its companions, they had despatched the caterpillar, and the three lugged it back to their nest in the tree, and undoubtedly hugely enjoyed their well-earned meal."

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

Microscopy.

Micro.—We may possibly give some articles on microscopy in Science Siftings in the near future, but it would be impossible to give detailed information on this very large subject here. The literature of microscopy is very extensive and the cost of the larger treatises by no means trifling. If you will state about the price you are prepared to pay we will be glad to recommend a book. But if the investment of only a small amount of money is in question, we would advise you to apply the whole of it in purchasing as good a microscope as possible. Objects for examination are abundant; or, where preparation is necessary, as in sections, etc., they can be bought ready mounted for a few pence. After practice has given you facility in the use of the instrument you may proceed to learn mounting, etc., for yourself by the aid of one of the small books published on that subject alone. You should write to one or more of the makers or dealers in microscopes, state what price you are prepared to pay, and ask for full details as to the outfit he can supply you with at that price. We recommend you to communicate with Mr. George Airy, 42, Gray's-inn-road, E.C. He is an importer of Continental microscopes, much cheaper than, but quite as powerful as the best English makes.

Miscellaneous.

Querist.—The sun's rays beating into a room do tend to slightly check the draught through an *open* fireplace. They cause the whole of the air in the room to become heated and give rise to an upward current in the chimney, that does not necessarily pass through the burning coal, and that tends, therefore, to crowd out as it were, the products of combustion on the free ascension of which active combustion depends.

W. S. Marsden.—We thank you for your letter which is, in the main, very interesting, but we cannot retract what was said on the subject of tea in the article you refer to. Our views are supported by no less authority than that of Leibig, but remember that excess of anything is bad. Respecting your observations about brown bread, the human system can adapt itself to almost anything, even poisons, but we question the desirability of trifling with the constitution.

Entropy.—We apologise for delay in replying to your query. It was accidentally overlooked. Crystallography with the microscope is a most interesting study. Many of the most beautiful examples of crystalline structure, such as snow crystals, can only be seen to advantage with microscopic aid, You can examine crystals while in procsss of deposition from the mother liquor. immersed in any transparent preservation liquid, or dry. No peculiarity in the construction of the microscope is necessary or desirable for your purpose. We recommend you to buy a good instrument. See reply to "Micro" above.

Pineapple.—Our statement as to the proportion of albumen soluble in pineapple-juice was, no doubt, the correct one, and that which you have read in the other periodical was not only quoted without acknowledgment, but quoted incorrectly. The authority referred to by the writer of our original note was, we believe, Dr. T. Chittenden, M.R.C.S., L.R.C.P., of Wheathampstead, Herts.

E. Kennedy.—Thanks for your letter which we find interesting, but rather too technical for publication. Our own reporters attend all scientific lectures, meetings, etc., and nothing of importance and of popular interest escapes them. We are, therefore, compelled to decline reports contributed by outsiders; and this applies to the article you send, notwithstanding its original and suggestive character.

Oeffelein & Co.—The specimen of the transparencies you were good enough to send us is certainly charming, but we are at a loss to know what is the nature of the advice you require. We shall be pleased to give you all the assistance in our power, if you will put your request in a more definite form.

Our Monthly Edition.

Science Siftings may now be obtained in Monthly Parts, bound in buff wrappers. Price 6d., or post free, 8d., of any Newsagent; W. H. Smith & Son's bookstalls; or of the Publisher, 78, Fleet-street, E.C.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers.

PRIZES FOR THE WEEK ENDING JULY 16th.

The senders of the first twelve letters, opened by us on Monday, July 18th, containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, the 18th instant, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 11th instant. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page i. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors for the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

AWARDS.

Our puzzle, we are pleased to note, continues to attract a fair amount of interest. Various competitors have sent in 145 solutions between them. The largest number of correct solutions from one competitor being 30. The awards have been duly made.

*** The Coupon will be found on page i.

NEWMAN & GUARDIA'S

NEW CHANGING BAG AND CARRIERS. FOR PLATES AND FILMS.

A perfect changing-box is at last offered to the public, greatly reduced in size and weight, with new and improved mechanism, and an Index showing number of exposures. Full Descriptive Price List, post free on application.

NEWMAN AND GUARDIA, Manufacturers of Scientific Apparatus,

71, FARRINGDON ROAD, LONDON, E.C.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*, 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, JULY 23, 1892.

SCIENCE NEWS AND NOTES.

"The world's a scene of changes, and to be constant in nature were inconstancy."—COWLEY.

"Science Siftings"

is now known in every quarter of the globe. We have readers and subscribers in every country, civilised and uncivilised. As an instance of what our agents are doing in some of the remote corners, we may quote the following extract from a letter received from Mr. J. Swain. He writes:—"I may say that I am a great admirer of your paper. I have seen it even in the heart of the Argentine Republic, at Lurcowan, more than 1,000 miles from Buenos Ayres." This is evidence of the value of SCIENCE SIFTINGS. Good things travel apace.

To Live Without Eating

is a scheme worthy to rank with inventions for perpetual motion, the transmutation of metals, and even the elixir of life. All these problems are boldly tackled, however, by the inventors of the present day. We learn that a company of Roumanian infantry officers and soldiers have just completed a march of 75 miles in 27¼ hours, starting from Kloster Dealn at 7.30 a.m., arriving at 10.45 a.m. the following day. The march was undertaken in order to test some new pastilles which are said to possess highly valuable qualities, and to take the place of both food and drink. At the beginning of the journey a pastille was handed out to the men every half hour, and, later on, three every hour. Every two hours the horses were given one of the pastilles dissolved in a small bucket of water, which seemed to suit them admirably, as they all arrived at their destination in splendid condition. Upon their arrival at Bucharest, both officers and men declared that they felt no fatigue whatever, and when they presented themselves before the Minister of War went through a review of their own free will. The pastilles are said to contain a large quantity of caffeine, Their success in this case was acknowledged, but further trials are to be made.

Juvenile Smoking

has been condemned not infrequently in these columns. That it is on the increase there can be little doubt, and we consider it quite time that it should be denounced by all thinking people, and authoritatively prohibited—anyhow, in the public streets—as it is in America and elsewhere. Stunted growth, impaired digestion, palpitation, and the other evidences of nerve exhaustion and irritability have again and again impressed a lesson of abstinence which has hitherto been far too little regarded. A further stage of warning has been reached in a case quoted by the *Lancet* as having come before the coroner for Liverpool. A lad was in the habit of smoking cigarettes and cigar ends, and after an attack of sickness died somewhat suddenly. The post-mortem examination revealed fatty changes in the heart, which there was little doubt, as the verdict held, had been fatally supplemented in their influence by the smoking habit referred to. This, of course, is an extreme example. It is also, however, after all, only the strongly coloured illustration of effects upon health which are daily realised in thousands of instances. Not even in manhood is the pipe or cigar invariably safe. Much less can it be so regarded when it ministers to the unbounded whims and cravings of every heedless urchin. Clearly there is need of some controlling power here. The parent in certain classes is almost as ignorant of consequences and probably often quite as apathetic as his boy. Where he can be roused to the active exercise of his authority in repression he should be. In very many cases he cannot, and we have therefore no hesitation in asserting once more our conviction that it is incumbent upon the legislature, in view of its known pernicious effect upon mind and body during boyhood, to restrict this habit by an age limit which will fall outside this period.

The Act of Breathing

is performed by most persons unconsciously and mechanically, and, therefore, they never give a thought as to whether they are performing that function in a wholesome way, and using the nose as a filter through which to warm and purify the air before it reaches the lungs. When we breathe through the nose, the cold, dry, impure outward air is sufficiently warmed, supplied with watery vapour and freed from dust. When we breathe through the nose, smelling at the same time through our organ of smell, which assists respiration, we become aware of the presence of an injurious or of a generally abnormal mixture drawn in by the breath, and can then either correct so unfavourable an atmosphere or escape from it. Furthermore, only in the nose are found those fine arrangements which can prevent the entrance of injurious substances into the deeper respiratory organs and thus stop the further advance of the hostile body, besides defying that which has already slyly effected an entrance. This is done by the so-called nasal reflex breathing, to which class belongs sneezing. If we breathe through the mouth, the air is neither sufficiently warmed nor satisfactorily moistened, and laden with all its bad mixtures of dust of mineral, animal and vegetable origin, added to injurious gases, reaches the larynx, the air tubes, and the lungs.

Snoring

is only the least among the evil consequences of breathing through the mouth. The swollen, sore, constantly chapped lips, bad condition of the front teeth and decay of the bac

ones (often attributed to the soft food we chew), a defective development of the sense of smell, frequent inflammation of the throat, attacks of fever, diphtheria and catarrh, and soreness of the larynx and lungs are consequences of breathing through the mouth which have been frequently observed. In children one often sees an habitual and peculiar weak or even stupid expression of countenance. It has also been found, through the experiments of different trustworthy observers, that there is a casual connection between stammering and breathing through the mouth. On the other hand, however, certain forms of nightmare and asthma are causes of breathing through the mouth. That infants are sometimes brought almost to death's door when prevented by a cold from breathing through the nose, is a fact well known to physicians. When a child or a grown person begins to breathe with the mouth open, there must exist some sufficient cause for the occurrence in the uppermost air passages. No one would voluntarily exchange the only healthy, comfortable manner of breathing through the nose for the burdensome and unhealthy breathing through the mouth. Let anyone attempt to breathe through the mouth for five minutes, instead of, as one is accustomed, through the nose, and he will soon be convinced that it is almost impossible. Almost of itself, that is, without muscular force, through the mere pressure of the air, the mouth closes and the original manner of breathing is resumed.

The Cure for Abnormal Breathing

lies as much as anywhere in the will power of the adult, with the reservation that it will be found difficult at first to control the mouth in sleep. With children this is especially the case. Whoever snores can, as a rule, not breathe through the nose. That it would be useless in such cases to desire to close the mouth mechanically is entirely comprehensible. Every mother, who frequently gives to her child the useless command "Close your mouth," is aware of this. Here it is better to seek, without delay, the advice of an experienced specialist, in order to determine the cause of this mouth breathing. In the case of children in particular an unnecessary delay might prove fatal. Now there are certainly cases in which the cause of of this habit may be determined and the habit still remain. But these are the exceptions ; as a rule normal breathing results as soon as the air enters the correct passages ; if the snoring and breathing through the mouth returns as an evil habit, then and only then can mechanical means be used with advantage to stop this opening of the mouth. The simplest of these is used by Dr. E. Bloch, of Berlin. It is to place a band from the chin to the top of the head. This often suffices. As the mouth remains closed by pressure of the air, some of the mechanical appliances to produce this effect might be used. Sometimes it is even sufficient to place a piece of celluloid plate between the teeth, but one would not likely decide to place a foreign substance in the mouth of a sleeper, particularly a restless child. All of these apparatus must be put on every evening, and worn overnight, until the normal position of the lips and lower jaw is regained. But the most important thing is to remove the obstructions to normal breathing.

Sea Bathing

is very popular just now, and will be more so as the weather becomes warmer and more settled. But it is not everyone who can afford a visit to the seaside, and, therefore, our readers will no doubt be interested in the comments of Mr. Albert Robin, of Paris, on the effect of mineral salts on the human system, when applied by the bath. A bath containing six per cent. of chloride of sodium, he points out, diminishes the amount of organic matter, uric acid, and extractive substances, but increases the inorganic compounds, the amount of nitrogen, urea, chlorides, and phosphoric acid. If the bath has twelve per cent. of common salt, it gives a brisk stimulation to the nitrogenous interchanges. A bath of twenty-five per cent. of salt influences mainly the process of oxidation, while it affects the nitrogen interchanges but slightly. This last strong salt bath is, therefore, advised for patients of sluggish digestion and oxidation, who suffer mostly from diseases of the skeleton, with rachitis or necrosis, or with anæmia. It is also good for all persons in whom the nervous system needs to be built up by economising the nitrogenous interchanges.

The Waters of the Dead Sea

might be utilised for antiseptic purposes. So far as known, no bacteria can abide in this sea, which is densely charged with chlorides of magnesium and sodium, and also contains in large quantities the bromide of potassium and lime. Whether this will ever be attempted remains to be seen, but meanwhile people of bilious habits and sluggish circulation will do well to take an occasional plunge into the sea, or when not so convenient to make use of the sea water imported daily into London by the Great Eastern Railway. The cost is trifling, and the hygienic results immeasurable.

The Utilisation of Smoke,

the antiseptic properties of which were so greatly appreciated by an authority in a recent issue, is now the subject of experiment by Mr. Mond. His object is to utilise the waste products in smoke. The smoke is led from the chimneys into a waterspray condenser, where it is claimed that he obtains four tons of sulphate of ammonia for every 125 tons of coal burned. This waste product is said to be worth in the neighbourhood £12 per ton. If the reports are correct, this would make the waste product worth about 8s. for every ton of coal burned ; this appears so great that it is very questionable whether the figures given are reliable. It is a very fine thing to have waste products to experimentalise on, but would it not be better in the case of coal to have no waste products at all, *i.e.*, to burn it, in the first place in a more economical manner, and so efficiently as to utilise all its energy. The waste products would then be too infinitesimal to be used as antiseptics or as the subject of Mr. Mond's experiments, and the country would be *considerably wealthier*, while the exhaustion of our coal supplies would be so much the more remote.

An Electrical Fog Annihilator

was suggested by us in the very first issue of SCIENCE SIFTINGS. It will be good news to our readers—*i.e.* to the wide world, that an enterprising American inventor having seen our suggestion, has actually carried the details into effect, with the result that an electrical fog annihilator has been tried at Sandy Hook and in Boston Harbour. No details are given of the method employed, but we learn that by one discharge 70,500 square feet, or nearly two acres, have been cleared, this being about 150 feet in either direction from the point of application. The fog closes in again from the surrounding area in about five to seven minutes, so that the discharges should be made about every two minutes. We await further details with great interest.

Patent Medicines

are consumed in this country by the ton-load. Sometimes their virtues are everything desirable, sometimes these essentials to efficacy are only conspicuous by their absence. Warner's Safe Cure, as an instance, has for its chief ingredient saltpetre to which is added sweetened water, and as saltpetre is good for the curing of beef in the barrel, it stands to patent medicine reason that it is a cure for kidneys in their cases. Nine-tenths of the cures or help effected by this class of remedies are the result of belief or faith that they will cure, and the keeping of the mind on the result to be obtained. Therefore, the directions are to take the remedy regularly and not to miss the hour. In many chronic cases of real or fancied ailments, to give a person a pint of clear spring water every hour, and thus flush the system, would effect a cure, especially if the patient would kindly believe that health was coming right along. However many people may still be prejudiced in favour of saltpetre, if so, they may buy as much for a few pence as they can procure for as many shillings if it is bottled and labelled by a patent-medicine vendor.

The Strength of Ice

is well known to be very great. A thickness of only 1½ in. will support a man's weight. Cavalry is safe on 4 ins.; an 84 lb. cannon on 6 ins.; and a railway train on 18 ins. thickness of the brittle solid. No doubt a part of this great strength is due to the incompressibility of the subjacent water; but it is equally certain that a thickness of a few feet or yards of ice presents in itself an enormously great resistance to sudden flexure. An inventor has proposed to utilise this fact in railroad engineering, to span morasses with a bridge of ice. He would immerse in the bog or swamp and along the line of the proposed railroad a length, or several parallel lengths, of piping. And he would pass through these pipes an artificially cooled gas or fluid. The pipes would congeal about themselves a solid track of ice or frozen ground on which the heaviest traffic would be safe. Radiation of heat into the surface and conduction from the subsoil would be slow, and therefore the circulation of cold fluid necessary to compensate for thawing would not be excessive. Wooden sleepers might be frozen upright in in the boggy ground, or in the water, and steel rails could be secured directly to the tops of these. River embankments of soft earth could be similarly hardened and protected.

The Military Applications

of this invention will be among the most important. Rivers may be dammed, or rivers and lakes may be crossed with safety by the aid of nothing but a few lengths of metal tubing, a steam engine or electromotor, and cold-producing mechanism. It is also suggested that a thick coat of ice similarly produced might form a good protection against torpedoes, etc., for ironclad vessels. The coating would increase rather than decrease the buoyancy of the vessel, and it could easily be loosened by steam heat, and removed, when necessary for racing purposes. Similar means might be adopted for checking navigation in a river; or artificial icebergs, self-propelled like automatic torpedoes, might be sent to ram the enemy's shipping. Balls of artificial ice might be found in some circumstances a good substitute for cannon shot or shell.

The Aurora Borealis

was seen in London, Oxford, and Cambridge, writes Mr. George Knight, on the night of Monday, April 25th, at 10.15, the first time since 1882. It seems to have been more brilliant than any seen in these latitudes for a very long time past. To find a parallel to this display we must probably go back as far as October 21st, 1882. Although a number of cases are on record in which the aurora was visible in isolated localities, no general display occurred between 1882 and 1870. There appears to be a certain periodicity in such appearances. The auroræ always accompany unusual solar activity. The enormous sun spots, which tell of such energy, Mr. Knight mentions, appear and disappear in a regularly recurring cycle of about 10 years. During the last few years the sun's face has been tolerably free from such blemishes, but within recent months spots of great size have been observed. During the auroral displays of 1882, a similar condition of things was observed, when an enormous spot measuring 56,000 by 51,000 miles and estimated to contain 2,000,000 square miles of surface was observed and photographed at Greenwich. As regards size, it was entirely eclipsed by the spot which showed itself about the middle of February last. This group, in length was 150,000 miles with a width of 75,000 miles. This spot was the largest ever photographed at Greenwich and the largest which had appeared on the sun since 1873. The face of the sun is now free from disturbances, although occasionally small spots are appearing, and it is quite evident that we have entered upon a period in which auroral displays may be expected to occur at somewhat frequent intervals.

The Sign Speaking,

or the mute language of the Indian braves, whose pretty encampment is now at the "Wild West" of the Horticultural Exhibition, eclipses anything in this way we have ever seen. It is quite as expressive as anything the white man can do with his mouth. Major Burke and Mr. Crager, to a friendly chat with whom we are indebted for our information, explained some of these signs to us. Thus, the right hand is pressed over the heart, and the palm of the hand is then turned outward, and waved away from the sign-maker, to express the pleasure of meeting, the significance being that the heart goes out. When the hand is pressed over the heart and the palm waved downwards, we are to understand that all is not well; but when the same performance is accompanied by an upward flourish of the hand, the idea naturally conveyed is that "things are good." We have not space here to give details of more of these signs, but we may mention that Colonel Nate Salsbury has a book in his possession which contains over five hundred pages filled with this practical, if silent, language. We had ample evidence of its utility in sharpening the wits for general purposes. While speaking to that sturdy-looking soldier, Major Burke, a Cossack approached him and made some remark in Russian, which language neither the Major, nor that linguistic adept, Mr. Crager, is acquainted with. Major Burke's genial face was clouded for a moment, until the Cossack produced a letter and shook his coat, when the Major immediately went to his bureau and produced an envelope, to the satisfaction of the Cossack and likewise himself. Indians, we understand, will flash signals for hundreds of miles with a miserable piece of looking-glass, and Major Burke tells us that our own heliograph and heliotrope originated in this discovery of the ignorant Red man.

MURRELL, in his work on poisons, says that about fifteen thousand children are killed every year by soothing syrups and other similar concoctions.

GLEANINGS OF THE GLOBE.

A SILKWORM'S thread is one-thousandth part of an inch thick.

NEVER use shot in cleaning glass bottles. It leaves a film of lead which is hard to remove and which renders any fluid put into the bottle unwholesome. Use finely chopped potato and warm water, shaking rapidly.

UMBRELLAS are rarely used in Aden, Arabia. Rain has fallen there only twice in twenty-nine years. Previous to the last rain, which occurred in 1888, there was a period of dry weather which lasted twenty-six years.

THE latest report concerning the Aborigines of the Andaman Islands makes it appear that the present generation will be their last. This interesting people have already disappeared from a considerable portion of their territory, and few children are now born, and those die in infancy.

EVERYONE may not know that the Bank of England notes are made from new white linen cuttings—never from anything that has been worn. So carefully is the paper prepared that even the number of dips into the pulp made by each workman is registered on a dial by machinery.

ONE day, in 1830, when a working jeweller, Joseph Gillott, now the famous steel pen maker, accidentally split one of his fine steel tools, and being suddenly required to sign a receipt, not finding his quill pen at hand, he used the split tool as a ready substitute. This happy accident led to the idea of making pens of metal.

REFERRING to a paragraph published on page 171 of our last issue, Mr. E. Kennedy writes that he is of opinion that his theory of the relation between sun spots and terrestrial temperature is fully borne out by the meteorological record for February last. He also states that reports of excessive heat during that month were received from the other side of the globe.

AMBERGRIS so highly valued in perfumery, is nothing but a diseased secretion of the whale's liver. In whaling seas it is often found floating on the surface of the ocean, and after whales have been captured an eager search is always made for the precious material. It is found much more abundantly in the lean and sickly than in the fat and healthy whales, but the lumps are rarely more than 1 or 2 pounds in weight.

THE kaleidoscope is of wonderful assistance in geometrical drawing, and people who suppose that this little toy is of no use, will probably be surprised to learn that the greatest portion of the geometrical designs employed in art and architecture are copied by the artist from the figures produced by the kaleidoscope. The instruments employed are somewhat larger than the toys sold in the shops, and some of them are fastened upon stands in such a way as will enable the draughtsman to retain his instrument in the same position for a considerable length of time, and thus give him an opportunity to make copies of the figures produced.

A NEW electric lock permits of any door or gate to which it is attached being either unlocked and left in this condition, or permanently locked, from any desired point.

IN 1883 a submarine observatory was constructed by Signor Toselli at Naples, enabling visitors to see the bottom of the sea. It was a steel chamber with plate glass floors and a collapsing float to sink it to different depths. It carried eight persons and was illuminated inside by electric light, while telephones communicated with the shore. It was quite possible to take photographs inside it beneath the water.

AN able electrical expert says that the prospect of moving ordinary trains by electricity is about as good now as the prospects of lighting cities by electricity were before the discovery that electricity could be generated by a dynamo-electric machine. The radical improvement looked for is the direct generation of electricity from the energy of coal, without the intervention of the boiler furnaces, the steam engine and the dynamo.

A CAT cannot see in utter darkness, but it can see in very diffused or dim light; and in order that the sensitiveness of its eye may not be injured by daylight there is a wonderful protective mechanism, which draws a curtain over nearly the whole eye in strong light, but withdraws it to the sides in the shade. By taking a cat suddenly from a dull room into a bright place we may actually see the opaque curtain slide from each side over the central spot of the eye.

MR. T. H. MORGAN, F.R.Met.Soc., writes from Zermatt, Switzerland, with reference to Mr. E. Kennedy's theory of the terrestrial influence of sun spots, published in our issue of the 2nd inst. He says:—"I think this theory can be upset by a single question. The greatest sun spot cluster ever recorded at Greenwich occurred in February last; Was this extraordinary manifestation followed by immediate manifestation of corresponding heat?"

AMONG the many differences between the alligator and crocodile there is one which is not mentioned in any of the books of natural history. The alligator never leaves fresh water, while the crocodile often goes to sea, and in the West Indies has sometimes been found many miles from land, but heading directly for an island possibly out of sight. How the creature knows to steer his course is a mystery, but he evidently knows where he is going and it is believed he always gets there.

ONE of the most curious of the many natural barometers consists of a half-pint glass full of water, a piece of muslin and a leech. The leech must be put in the water and the muslin tied over the top on the glass so that the creature cannot get out again. When fine weather is to be the order of the day the leech will remain at the bottom of the water, coiled up in spiral shape and perfectly motionless. If rain is to be expected it will creep to the top of the glass and remain there till there is a likelihood of more settled weather. If there is to be a storm of wind the little animal will contort itself violently and squirm about. For some days before thunder it will keep out of the water almost all the time, and will occasionally move its body in a convulsive fashion. For frosty weather it behaves in the same manner as for fine, and it foretells snow in the same manner as it does rain.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 38.

151.—What are the physical characteristics and market prices of the metals more costly than gold ?

Gold is worth about fifty-one pounds sterling per pound troy. It is, therefore, exceeded in value by iridium, a steel-coloured brittle metal, highly infusible, and worth £60 per pound. Iridium is a very dense metal, its specific gravity being 22·4, while that of gold is only 19·2. Still more costly is gallium, at £75 per pound—a tough metal of bluish white colour, and having a specific gravity of only 5·9. Gallium melts at a temperature of only 30° C. The next metal in the order of rarity is rhodium, sold at rates corresponding to £85 per pound. Rhodium is a silver-coloured very infusible metal, of specific gravity 11·1. Finally osmium, priced at £120 per pound, is a bluish-white hard metal, also very infusible, and having a specific gravity of no less than 22·5. In fact, osmium is the heaviest of known bodies.

152.—Why are rain-drops globular ?

Free liquid surfaces, by virtue of what is called surface tension, behave as if they were constituted by pieces of stretched elastic skin, that is to say, they tend to contract in all directions, to draw—themselves together into a form having the smallest possible area. In a falling rain-drop the liquid is as nearly as possible free to assume any form determined by its own molecular properties; and for the reason just stated—in order that the exposed surface may be as small as possible, consistently with the bulk of the drop—this form is spherical.

153.—What description of compass is now employed in high-class sea-going vessels ?

The most remarkable, and, as is generally acknowledged, the most successful form of compass is that patented in 1876 by Sir Wm. Thomson. The card consists of a central boss and an outer rim, both of aluminium, connected together by fine silk cords. Eight or twelve small magnets, 2 or 3 inches long, having their corresponding ends tied together by threads of equal length, are suspended by silk cords from the rim, to which is attached thin paper marked with the points of the compass and degrees, The concentration, in this wise, of the greater part of the weight in the rim, gives a long period of free oscillation, and, consequently, great steadiness; and as the card of a 10 inch compass, with its suspended needles and sapphire bearing, weighs only 178 grains, the frictional error is very slight. Thomson's compass is now employed on nearly all high-class steamships.

154.—On what grounds is it asserted that the sun is not fixed in space ?

The fact, or supposed fact, that the sun has a proper motion of about 5 miles per second is deduced from observations of the apparent proper motions of the "fixed" stars. If we knew certainly that the great majority of these "fixed" stars were not drifting through space with a common motion not shared by the solar system, then we might assert with absolute confidence that the sun is moving in a direction represented by an approximately straight line drawn to the constellation Hercules. But since the possible existence of such a stellar drift has not been disproved, we can only assert that the sun's hypothetic motion has been argued, in accordance with the mathematical theory of probability, from a large number of careful observations. It should be added that great uncertainty as to the distance of many of the stars adds much to the complexity of the problem in question.

155.—How is ice made by machinery ?

There are two methods by which mechanical power can be used for the production of cold. One of them involves the employment of an air-pump, by which the atmospheric pressure is removed from the surface of a volatile hydrocarbon or other liquid. Removal of this pressure results in the evolution of vapour by the liquid. But vapour cannot be produced from a liquid without the absorption of a considerable quantity of heat—the "latent heat of vaporisation." While, in the freezing machine, the exhaustion is maintained and the evolution of vapour, therefore, kept up, there will be continued absorption of heat in the vacuum chamber. And ice can be made by simply surrounding this chamber with the water to be frozen. Another process depends upon the fact that the amount of heat contained by any given quantity of air is proportional to the volume that it occupies. Air is compressed to a very small volume in metal pipes, surrounded with water, by which the superfluous heat, due to contraction of bulk, is carried off. The compressed air then passes into a chamber where it is permitted to suddenly expand, and where it derives the "latent heat," proper to such a condition of expansion, from the surrounding matter, which may, of course, as in the previous instance, be water that is required to be frozen.

156.—What is the cause of long and short sight, and how may it be remedied ?

A number of physiological conditions, the explanation of which within measurable limits of space, would presuppose a knowledge of the anatomy of the eye, may be concerned in the production of long or short sightedness (called by opticians respectively hypermetropia and myopia). But, from another point of view, the facts of the case may be very simply enunciated. It is as if, in the case of long sight, the ground glass of a photographic camera were immovably fixed too near to the front to show a distinct image of any object, no matter how distant, at which the lens might be directed. Here the lens corresponds to the optical system, and the ground glass to the retina of a hypermetropic eye. The more nearly an object is looked at through the agency of such a camera, or by such an eye, the more hopelessly out of focus will it become. But, in either case, the addition to the optical system of a suitable binocular lens will remedy the defect. This addition, under the name of biconvex spectacles, is widely used as an aid to refraction, as a means, that is to say, of causing images to be focused nearer to the front of the eye. Short sight, on the other hand, may be compared with a camera too far drawn out. The retina may be too distant from the front of the organ of vision. And biconcave spectacles are called for, to diminish refraction or to throw the projected image further back. Otherwise, the accommodation of the eye (which is

analogus to a self-acting *focusing adjustment*), being limited in extent, only very near objects can be brought within the range of distinct vision

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

163.—Why does an intaglio (depressed) image become, apparently, a cameo (relief) image, and *vice versâ*, when viewed by candle light through a convex lens ?

164.—Do ventriloquists speak from the throat, or, as is sometimes stated, from the stomach ?

165.—How is electricity measured, and what is the unit of this force practically employed in connection with electric lighting ?

166.—What is the explanation of the spectral forms that sometimes seem to dance before the eyes in illness ?

167.—Why is the summer so much hotter in the Southern than in the Northern Hemisphere ?

168.—When is our neighbour, the planet Mars, to be seen to the best advantage ?

SINGULARITIES OF SUICIDE.

Is suicide evidence of insanity ?

The question involves a discussion not easily handled. The most vital instinct in man is the preservation of life. It would seem, therefore, that an act which traverses the first law of nature must emanate from a disordered brain. Not long since a judge held that suicide *per se* was evidence of insanity. On the other hand we have the examples of eminent men who have taken their own lives under circumstances which appear to leave no room for doubt as to their sanity.

A recent dispatch from Roumania informs us of a suicide club, the members of which are pledged to commit suicide as soon as their names should be drawn. The surviving members of the club have all been placed in rigid confinement, and will be tried on the charge of having deliberately aided and abetted unjustifiable suicide.

It is remarkable how a suicide by a certain method or in a certain place will lead to another of the same kind. A surgeon of the Middlesex Hospital went into a barber's shop to be shaved. The barber spoke of a man who had been unsuccessful in an attempt to kill himself by cutting his throat. "He could have easily have managed it," said the surgeon, "had he been acquainted with the situation of the carotid artery." "Where should he have cut ?" asked the barber. The surgeon told him. He at once left the room, and, not returning as soon as was expected, the surgeon went to look for him and discovered him in the yard with his head nearly severed from his body.

It is worthy of note that the greatest number of suicides are commited by the Germans. The form of death they choose is usually poisoning.

In every country three-quarters of all the suicides are of the male sex.

It is almost impossible to realise the readiness with which the Chinese commit suicide. It requires the merest trifle to induce a Chinaman to hang himself. In other countries when a man wishes to avenge himself on his enemy he kills him. In China he kills himself. Suicides of widows are very common there. Many hang themselves publicly, having given notice of their intention so that those who wish may be present.

On the morning of the appointed day the willing victim, dresses in gaudy apparel, and, holding a bouquet of fresh flowers in her hand, is carried in a sedan chair to the temple erected in memory of "virtuous and filial widows." There she performs the accustomed religious rites, with burning of candles and incense. In the afternoon she returns home and hangs herself before the multitude. Suicides of this kind meet with general approval in China. They do honour to the families in which they occur.

The first instance of suicide recorded in Scripture is that of Samson (B.C. 1117). The second is that of Saul (B.C. 1055). Rather than fall into the hands of the Philistines, when hard pressed in battle, he drew his sword and fell upon it, and so died. Judas Iscariot, through remorse, went and hanged himself.

Among the philosophers of antiquity Seneca stands pre-eminently forward as the defender of suicide. He says : "Does life please you ? Live on. Does it not ? Go from whence you came. No vast wound is necessary ; a mere puncture will secure your liberty." Pliny says : "God can not end his own life, though he wish, but has given to mortals this best of boons amid the burdens of trials of life."

Two of the most distingushed men of antiquity who sacrificed their own lives were Brutus and Cassius. Mark Antony, reduced to a desperate extremity, killed himself. Cleopatra was taken a prisoner by Augustus, who had intended to exhibit her in a triumphal procession in Rome. To frustrate this design she killed herself by the poison of an asp. Cato, rather than live under the despotism of Cæsar, stabbed himself, and when the wound had been staunched, tore off the bandages and accomplished his purpose. Demosthenes, fearful of being subjected to slavery and disgrace, resorted to self-destruction. The persecution to which Hannibal was subjected by the Romans impelled him to have recourse to the poison which he always kept about him in a ring. Isocrates, the renowned Athenian orator, starved himself to death sooner than submit to the dominion of Philip of Macedon. Thomas Chatterton, the poet, became indigent to the verge of starvation, and at the age of 17 poisoned himself.

From instances like the foregoing one might well query whether the act of taking one's life is alone sufficient to indicate insanity.

The law regards suicide as a crime, putting it in the same category with murder. Of course where the crime is consummated no punishment is inflicted, but all attempts are punishable, and principals in the second degree, present, aiding and abetting, and accessories before the fact, can be punished. For many centuries suicide has been regarded as a crime not only by the State, but by the Church. In the Greek Church, the Roman Church and the Protestant Episcopal Church it is severely condemned, and the burial service provides that the prescribed office for the burial of the dead is not to be used for any who have laid violent hands upon themselves. In England the crime was punished by the forfeiture of estate, and the body of the self-murderer was required to be buried in the open highway and a stake thrust through it to mark the public detestation.

This law was repealed during the reign of George IV. ; but even now the body of a suicide is required to be buried at night without the performance of religious rites. These laws of the State and Church must be founded upon the idea of suicide without insanity, otherwise they would be monstrous.

THE HISTORY OF A BACILLUS. *

The most distressing aspect of bacilli is their preference r the human interior. This is their natural hunting ground, their breeding haunt, and they do not seem to be happy until they have firmly located themselves in the meshes of our tissues and organs. By some cunning device an enterprising bacillus gains admission to our organs and at once makes for the blood-vessels, along which it placidly glides on the stream of blood as it courses through the body until it spies a likely corner. Then it lands, instals itself in a comfortable home and settles down to rear a family. The birth-rate is high, development is rapid, and in a few hours grown up children sally forth to seek a home for themselves and in a few days colonies are so innumerable that families become a tribe, and the tribes become a nation. Meanwhile the unseen hosts take possession of their victim; he sickens, takes to his bed, while the imps pasture and gambol at will all over his body. The doctor is called in to wage war against the enemy; and who has armed him with the weapons suitable for a successful attack? We must date the first idea of germatory disease to Edward Jenner, although a quack doctor tells us in the *Morning Post* of June, 1782, "That he will show with the aid of his microscope the insects that caused the influenza of 1781 as large as birds," but we know that "quacks" are always in advance of all science.

It was M. Pasteur who gave the first great impulse to the science, by proving that alcoholic fermentation actually depended upon the growth of the yeast ale, and this laid open the whole theory of the fermentative action of other fungi. The more we study the life histories of these minute organisms, so potent in causation of disease and in the preservation of life, the more we are struck with the similarity that exists in their behaviour individually and collectively in their modes of developement and action within certain environments, that is to say, under the influence of circumstances and species and soil, all of which are of importance in determining the physical character and vital properties of these minute vegetable organisms, as well as of the higher forms of life. The flea that feeds on other fleas has nowhere its more perfect prototype than in the pathogenic and pathological bacillus. The micro-vaccini goes down before the putrefactive bacterium. It is said the putefractive bacillus is the foe of the bacillus of cholera and also of bacillus prodigiosus. Some have said that by planting one kind of bacteria another is driven out or the medium on which the former fed is eaten up. Cagniard after nearly 200 years interval watched with wonder the torula cerevisce as it budded into existence in the microscopic field and announced to the world that yeast was a minute plant. "I will undertake," said Pasteur in one of his addresses, "in the space of 24 hours to cover with mycrodermo aceti a surface of vinus liquid as large as this hall in which we are assembled. I should only have to sow in it the day before almost invisible particles of newly formed mycrodermo aceti." By the aid of the microscope we can develop the hidden treasures of nature, and while the veil of obscurity is being lifted aside, photography comes in and faithfully delineates every object, and the lantern holds it within our gaze.

In particular you will be surprised to learn that the mouth is the portal by which innumerable germs enter the body, and the breeding chamber in which they flourish. The conditions of their existence and multiplication there present being eminently favourable for their reproduction. Professor Miller in an interesting paper read befoer the bacteriological section of the International Congress on Hygiene said, that bacteria allowed to accumulate in the mouth may give rise to a large number of diseases, both local and general, which hitherto baffled all attempts to account for their origin.

Now, in the first place, what are bacteria? People have very confused ideas of these organisms. When Frank Buckland, some years ago, wrote to the Brighton Aquarium Company that he was sending them three or four specimens of the sea horse, they sent up several large tanks about the size of horse boxes for their reception; when, as a matter of fact, they are no larger than a good sized prawn, and could be carried down in an ordinary tumbler. And, in like manner, some people imagine bacteria to be insects of various odd shapes and form, but they are plants belonging to the class of fungus named bacteria, from the Greek word signifying a stick or rod, owing to the rod-like form characteristic of many of them. These fungi are characterised by the absence of the green colouring matter of the higher plants. It is this matter which enables the algæ and the higher plants to use the carbonic acid present in the atmosphere and in water and to convert it into oxygen. The fungi not containing this substance require already formed organic substance for their food. The presence or absence of totalising matter is not now, however, held to be a distinguishing feature of the class, as some bacteria even contain it.

The fungi are most conveniently divided into four principal groups. (1st) The bacteria or fission fungi. (2nd) The moulds. (3rd) The budding fungi or yeasts. (4th) The slime fungi. Of these four groups that of the bacteria is the one with which we are most intimately concerned this evening. I have, therefore, placed them first although they are more simple in form and in their mode of reproduction than are numbers of the other groups. Now, as regard reproduction, the group of bacteria or fission fungi owes the latter name to the simple mode of reproduction which is the usual one in ordinary conditions, each cell becomes constructed in the middle and finally divides into two equal portions, one being the exact counterpart of the other. Chiefly as a provision to insure the continued existence of the plant in certain adverse circumstances another mode of reproduction by spores is provided for. Bright shining spherical or ovoid bodies appear within the cells. These rupture the cell wall and escape, and existing as free spores they are of a very indestructable nature, being able to resist great extremes of heat and cold. By the ordinary method of fission which usually takes place when there is suitable nutriment for the organism an amazingly rapid growth takes place. Many bacteria divide in the course of one hour, some in less time. The calculation made is that in 24 hours 16 million will have been formed from one cell, but when we think that when conditions are favourable to growth, as in some diseases, not only one cell but all the cells present at the time are undergoing this enormous increase, the mind utterly fails to grasp the idea of the number of organisms produced. The exhaustion of the food supply, and the struggle for existence, with other bacteria put a limit, however, to this increase. Many bacteria also secrete substances which are injurious to their own further growth.

Since the discovery of the dependence of many diseases upon micro-organisms, much controversy has been held as

* Condensed from a paper, illustrated by the lantern, read by Mr. A. King, the hon. sec., before the Margate Amateur Photographic Society.

to the stability of the divisions described as distinct species, some observers holding that one form could change into another form, and that there was no reason why an innocent form should not turn into a virulent form or *vice versa*, but more careful researches have established the fact that the species of bacteria are constant. While there are species that exhibit changes of form, there are others that do not and those that do exhibit such changes of form may still be distinguished by mode of growth, etc.

Professor Koch has shown to the satisfaction of most bacteriologists that the transition of a dangerous into an innocent organism, such as the conversion of anthrax into the hay bacillus never takes place, and the statement was owing to an error of observation due to the employment of improper methods.

It will not be uninteresting to give a short description of the methods employed in the investigation of yeast organisms. If we take a packet of the smallest seeds of the higher plants, say for instance, prymilla, not visible some of them to the eye, we shall most likely find, though they are sent to us as the genuine seeds unassociated with any others, after they have germinated and grown up there are endless other seeds, that at the time were floating in the air and settled with these, and we find it an impossibility to produce an unalloyed pure growth insuring nothing but the pure and perfect plant we are expecting without other growths arriving with them. There would doubtless be little difficulty in finding some scientific method of separating these seeds and getting pure growths, but it is of little importance. Science is not, therefore, called to its aid. As soon as it was discovered that these minute organisms could be cultivated or grown on artificially prepared nutriment, various substances were made use of, but they were all of a fluid nature. The early investigations were met by one great difficulty. There were such a multitude of these organisms present in the air, and in our other surroundings, that it is exceedingly difficult to prevent the access to these cultivations of numerous germs, which interfere with the growth of the one we are studying, and this difficulty is especially great in cultivations in liquid media.

In liquids such as beef extract, containing the materials on which the bacteria could live and grow, all innoculated with a small quantity of the substance to be examined, and by means of a process of gradual dilution, pure cultures are at length obtained. The employment of fluid culture media is attended with many difficulties, but it is still the principal method employed in the school of Pasteur, and elsewhere it is now used for the rapid preparation of large quantities of any particular organisms. When slices of boiled potatoes are exposed to the air in a damp situation, they soon become covered with small spots and shining drop-like particles. These are growths from germs in the air which have fallen upon that particular spot on the potato. These separate spots of growth consist of one particular bacterium only, which has had room to grow in the place where it alighted. Had this germ fallen into the liquid beef it would also have grown, and have become mixed up with all the other bacteria from the air which also fell into the liquid. Professor Koch seeing the importance of this observation, and to overcome the drawbacks of the potato being an opaque substance, conceived the important idea of employing a transparent medium—gelatine—as a basis for the material. And great advance was made by this discovery. The transparent gelatine was very readily liquified by heating and again consolidating it combined the advantages of both the liquid and the solid media. Having some fluid, as water or saliva, or the scrapings from some bone to examine, how should we proceed? The first important consideration in all these investigations is the exclusion of all germs except those which we wish to cultivate—that is to say, we must sterilise the instruments and apparatus.

Supposing we wish to examine a species of saliva, and separate it from the organisms which are capable of being cultivated out of the mouth. Test tubes are thoroughly cleaned and plugged with cotton wool. They are then placed in the hot air fertiliser—an instrument with a double iron casing heated from below a gas flame. In this they are subjected to a temperature of 150° C. for half an hour. They are then filled with the liquified gelatine with which the suitable nutrient materials have been previously combined; the sterilised cotton wool plugs are re-inserted and the tubes of gelatine subjected to steam at boiling point—preferably for half an hour for three successive days. This is best done in the steam steriliser of Koch, a convenient form of boiler covered with a felt jacket to sustain the steam at the required temperature. By these means all the germs in the gelatine are destroyed.

Taking a tube of sterilised gelatine and a platinum needle, we hold the needle in the flame of a Bunsen burner until white hot. All germs which have settled upon it are thus effectually destroyed. It is a good rule never to take up or lay down a needle without bringing it to a white heat in the flame. Dipping this needle into the saliva, we transfer it to a tube of liquified gelatine, and disseminate it well in the material. Taking a second tube after again sterilising the needle, we dip from the first tube to the second four or five times, and twist up a horn of the cotton to indicate that this is the first dilution. We go through the same process with another tube, indicating in the same manner that this is the second dilution. It is generally best to make at least three dilutions from the original tube. Upon this levelling apparatus, which contains ice in the glass receptacle, we place a sterilised plate glass and pour out our gelatine upon the plate, cover it with bell glass to keep out other germs, and leave it to set.

The same thing is of course done with the contents of the other tubes. When the gelatine is set, the four plates are stacked in a damp chamber (a covered glass vessel having a layer of moistened paper at the bottom) labelled, and kept apart by these glass benches. After an interval of from 12 to 24 hours, the plates are removed and examined under the microscope, and small colonies are seen to have grown in the solid gelatine. These colonies will be of various descriptions according to the germ which has been arrested in the gelatine at any particular part of the plate.

As in the potato cultures the colonies are free to grow by themselves. In the first plates they are very crowded together and are correspondingly small. In the third and fourth plates they are more scattered, and having more room to grow to a larger size we thus see that from our mixed germs in the saliva, we have a number of separate colonies of distinct bacteria. Placing the best plate under a low power of the microscope, the colony may be removed from it with a platinum loop and transferred to a tube of gelatine. If care has been used to omit no precaution, we shall have in our tubes pure cultures of organisms which in the saliva were so intimately mixed together.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.
Or from Messrs. W. H. Smith & Son,
and through any Newsagent.

THE FORCES OF NATURE.

Mr. Preece is anxious to attract our attention especially to the facility which the electric current gives us to bring power to our doors and to enable us to facilitate home industries. The congregation of large bodies of males and females in magnificent buildings is a modern consequence of great industries dependent on the presence of great power and great steam engines. A system of centralisation has followed, which is not always beneficial to healthy mental and corporeal growth. The electric current steps in to check this system. It enables us to apply in our own dwellings power from the smallest fraction of a horse-power to many hundred horse-powers.

The economy of the transmission of energy by electricity is a question of pressure. The higher the voltage (pressure) the smaller the conductor needed and the greater distance to which it is possible to transmit the energy. It is difficult to obtain high voltages except through the aid of alternate currents and by means of induction apparatus which transform low to higher pressure. The apparatus for doing so is extremely simple and effective. The Ferranti apparatus in Deptford generates 10,000 volts directly by a dynamo which drives currents eight miles to London, and is there re-transformed down first to 2,400 and then to 100 volts for electric lighting purposes. At Lauffen, on the Neckar, a turbine worked by the falls there, absorbing 300 horse-power with a head of 10 ft. excited a dynamo to 50 volts and 4,000 amperes. These low-pressure currents passed through a transformer which raised the voltage to 16,000 volts. Three small bare overhead copper wires (No. 8 gauge), insulated on oil insulators, conveyed this energy to Frankfort, 108 miles away, where it was transformed down to 75 volts, and there used both for motor and for lighting purposes. The apparatus worked during the existence of the Frankfort Exhibition last year, and it is now employed in lighting electrically the town of Heilbronn, nine miles distant from the falls, but at a pressure of 5,000 volts. The peculiar feature of this Lauffen system is the use of three wires and three alternating currents, one in each wire, flowing at different phases, following each other like the relative motions of the three cranks of a three-cylinder steam engine or of a three-throw pump. This "Drehmstrom" cures all the defects of alternating motors ; it causes no disturbance to contiguous telephones and telegraphs ; it is sparkless and safe, and the apparatus is remarkable for its simplicity.

The system has been practically worked out by Tesla in the United States of America, and by Dobrovolski in Berlin. It solves the question of economically transmitting energy to great distances. Coal may be burnt at the pit's mouth, and 75 per cent. of its useful electrical energy delivered in London. The energy of the Swallow waterfall at Betts-y-Coed may light up the streets of Liverpool. The foaming torrents of the Highlands can be made to drive the tramcars of Glasgow. It is proposed to transmit energy by this method from Niagara to Chicago next year—a distance of 500 miles—and this can certainly be done with a voltage of about 40,000 volts, and with an efficiency of about 60 per cent. ; 5,000 horse-power generated at Niagara would deliver 3,000 horse-power at Chicago. The principal cost of the system lies in the construction and upkeep of the wires ; the cost of the plant is small, and the labour insignificant. It remains to be seen how the relative economy of coal carriage and energy transmission will affect this great industrial question. Anyway, we may conclude that the experiment at Frankfort has practically solved the question of transmitting energy to a distance and of working motors by alternating currents.

How, then, are we to utilise the waste forces of nature ?

The sun's rays pouring on the desert of Sahara are generating the equivalent of millions of horse-power in the heat absorbed by that great sandy waste. Sunshine is power. Coal is merely preserved sunbeams. The solar heat acting on one acre in the tropics would, if it were possible to utilise it, produce 4,000 horse-power for nine hours every day. To utilise this heat is not a mere dream ; it is certainly possible to convert it into electrical energy by thermo-electric apparatus, though I have not yet heard of its being done.

The earth itself in its daily rotation round its axis is an immense store of energy. If we could by any means reduce a little of this spin, we should lengthen the day, but we should obtain energy. Mr. Gisbert Kapp has calculated that if the day increased only one second 100 years hence we should during the whole of this century obtain 10,000,000 horse-power continuously. There is no doubt that the tidal wave is gradually acting upon the earth's spin in this way, but the energy is not available for man, and it is one of our wasted energies.

The tides of the ocean, surging backward and forward with unerring accuracy, produce in our estuaries and straits movements of great masses of water which, if utilised as power, could be turned to useful account. Take the case of the Menai Straits, whose breadth at Belan, the entrance from Carnarvon Bay, is 1,188 ft., and mean depth about 50 ft. This gives a sectional area of water of approximately 60,000 sq. ft., flowing either in or out four times a day at a mean speed of 3 knots per hour, which gives a velocity of 5 ft. per second. The effective energy of such a stream would give 6,000 horse-power, if it could be utilised. At the present moment, not one fraction of this wasted power is employed other than that for the motion of ships and boats. The total tidal area of the estuary within the mouth of the River Mersey at New Brighton is 22,500 acres. The mean total volume of tidal water passing in or out of the estuary four times a day is 4,455 million cubic feet. The mean rise or fall of the water above tide level is 10½ ft. ; that is, the mean vertical range of the tide at Liverpool is 21 ft., reaching 31 ft. on equinoctial springs, and 10 ft. on lowest neaps. This would give an available power of about 100,000 horses, if it could be utilised ; but this is, of course, an impossibility.

In some estuaries the flood tide is caught by dams in a kind of dock, and made to work mills in its ebb, but with a rise and fall of 6 ft. it requires a dock area of 10 acres to give 20 horse-power. But tide mills are very expensive in their prime cost, and they are rarely resorted to unless nature has favoured their use by unusually high tides or by convenient geographical configuration. The power executed by tidal rivers is much less than is usually considered. The total tidal energy of the Thames at London-bridge is 320 horse-power, from which we could not extract usefully more than 100 horse-power, and that only by stopping the whole navigation of the river. The available energy passing through one archway is only 20 horse power. The total available energy of a slow shallow tidal river like the Thames is therefore comparatively small, and its inconvenience would be so great that it is not worth consideration.

It is different with a constant flowing river. In a constant moving mass of water the work done per second by the stream depends on the pressure exerted by the water on the effective float area exposed to the stream, and on the rate at which the water flows. The whole energy of a stream running at 5 ft. per second (3·4 per hour) against a

resisting float surface of 5 sq. ft. would exert approximately one horse power, and if the efficiency of our machinery be 50 per cent., 10 sq. ft. will give us about one effective horse-power. Hence it is not a difficult problem to utilise the energy of a current of water on a small scale, especially as the energy increases as the cube of the velocity.

An extremely ingenious hydraulic motor has been devised by two young engineers, Messrs. Purdon and Walters, of Great George-street, which, moored in a stream, absorbs the energy of the moving water in a novel and effective way, and converts it directly into electrical energy. One is going to be fixed in the upper reaches of the Thames to form a charging station for electric launches. The energy of the falling river will thus be utilised to drive boats up the stream against its own resistance. The quantity of water going down the Seiont from the beautiful lake of Llanberis is approximately five million gallons per days, and it falls about 300 feet. Hence the whole energy of the river, if it could be utilised, would supply a constant power of 320 horses. There are already several mills on the stream utilising some of this power; but enough remains, at any rate, to illuminate the streets of Carnarvon with the electric light. Forty million gallons of water will be daily brought to Liverpool from Lake Vyrnwy when the system is complete. The top water level of the lake is 820 feet above the level of the sea. The total energy continuously expended by the fall will therefore be about 7,000 horse-power.

Of course, much of this energy is expended in overcoming the friction against the sides of the aqueduct, in delivering the water into the houses of the consumers in Liverpool, and in maintaining the service, but there must be a good deal of energy wasted; and it is well worth the consideration of our water authorities whether some utilisation of this wasted energy in water works generally cannot be effected so as to deliver it in the form of electrical energy in our streets and buildings. The whole of the streets of Liverpool could be brilliantly lighted by the energy wasted in the Vyrnwy aqueduct.

Water as a source of energy is found where nature has placed it, and not where it can be most conveniently used. The electrician has, however, interfered with nature, and has enabled man to extract the otherwise wasted energy, and to lead it where he wills. The energy of moving water has not hitherto been much sought after in the United Kingdom, because coal is cheap, but now that strikes are rampant, the wise seek wind and water.

Wind is a somewhat fitful source of energy, but it has served its purpose, and has done good service in the past. It is still in great request upon the ocean, and in lands where coal is dear and air is cheap. It is much used for irrigation, and its energy can be stored either by raising water or by accumulating chemical energy in secondary batteries. Mr. Brush, in Cleveland, U.S.A., has used a windmill to light his house, and Messrs. Carwardine & Co., in the City-road, London, utilise about 3 horse-power in this way every evening. An ordinary windmill, having four sails, in a pleasant breeze of 10 miles an hour, gives about 2 horse-power; and the small American circular mill, so much in request now, gives on an average about one horse-power.

The power exerted increases with the area exposed, and with the cube of the air velocity. A wind blowing at the rate of 10 miles an hour, or say 15 ft. per second. will exert such direct pressure on a sail 130 sq. ft. in area that it will drive a boat before it with the power of a horse. The largest sailing ship in the world has just been launched at Port Glasgow, which carries a sail area of 57,000 sq. ft., and has a tonnage of nearly 4,000. Such a wind would exert upon her a power equivalent to 440 horse-power. Wind is, however, practically available only for small powers, and in exposed positions on land. There are, however, many places where country houses could be supplied with the comfort and luxury of the electric light if this errant force of nature were curbed and brought under subjection.

While our wants are so readily and so cheaply supplied by our coal fields there is little chance of much attention being directed at present to other sources of energy; but with the diminution of our output, and the cranks of our labour communities, the attention of our manufacturers and of the custodians of our health, safety, and comfort must be directed to those neglected energies which are now "wasting their sweetness on the desert air."

(Concluded from last week.)

ANOTHER OPINION ON HOMŒOPATHY.

An American homœopathic physician, who contends that homœopathy contains all of science that there is in medicine, sends us some comments relative to what has already appeared in SCIENCE SIFTINGS on the subject. He writes:—"In the first place the writer evidently has no more knowledge about our methods of preparing dilutions than a babe unborn. We make our dilutions either by the decimal or centesimal scale. *One* drop of atropine (or, more properly speaking, *one grain*) added to *nine grains* of alcohol gives us the *first decimal* dilution. This is the *first dilution* that the writer speaks of, and if you would compute the fraction of grain that would be in a first dilution, according to his statement and mine, you will find such a vast difference that you should thereby place no reliance on any statements such a writer makes.

"The first centesimal solution is gained by adding one drop of mother tincture of any drug to ninety-nine (99) drops of alcohol. While this represents the first centesimal dilution it also is the second decimal. One drop of the first decimal is added to nine drops of alcohol to make the second decimal, and so on by each weaker dilution. All explanations regarding the method of action of the infinitesimal dose are merely theorising—all we can be comparatively sure of is the result one gets."

The writer then refers to the benefit derived from nux vomica by a patient whom he treated for loss of appetite. "That was," he tells us, "in the sixth decimal dilution, and every grain of that dilution contained only the one-millionth of a grain of the drug.

"We can never," he admits, "be *absolutely certain* of the curative action of any drug, whether it be administered on the homœopathic or allopathic plan. It is only possible to *infer* the beneficial result of a certain remedy from the knowledge we possess as to the general course of disease, and this is influenced by so very many things that we can never say positively that the remedy given produced a cure. We can feel firmly convinced of the curative action, but could not demonstrate the fact with mathematical exactness."

AN INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. I, price 1s., post free, 1s. 2d.

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

WHY BROWN BREAD IS GOOD

An article in a recent issue of SCIENCE SIFTINGS has been brought under my notice entitled "Why Brown Bread is Bad." By the kind permission of the editor, writes Dr. J. R. Allinson, L.R.C.P., I will answer it and show the writer his mistake.

The writer of the former article asks why has not the offal of flour mills been made into a medicine? It has, and is widely sold as dysyepsia cakes. I also recommend my patients to take bran biscuits with them on a sea voyage, or to make and eat these biscuits if they are living in some place where wholemeal bread cannot be obtained. By means of these biscuits, constipation, and the train of evils which result from it, is prevented.

The writer next asks, will brown bread prevent or cure constipation? Certainly; I have cured thousands of cases of constipation by it, and have not yet seen a case I could not cure by its means. Of course, in obstinate cases I advise wholemeal bread puddings to be eaten in place of milky ones. The bran is a valuable constituent of bread for many reasons. It separates the particles of food, and allows the gastric and intestinal juices to penetrate, and dissolve out all the possible nutriment. It also fills up the 33 feet of bowel which we have in the abdomen, and by its bulk sets up reflex action and daily expulsion of useless and refuse materials. The 33 feet of bowel need insoluble matter to fill them up before they will act.

The writer asks the influence of brown bread on the teeth. If he will consult "Cooley's Toilet and Cosmetic Arts," he will find this sentence: "The people of the North of Europe eat coarse black bread, and dentists and dentistry are unknown amongst them." If he will consult "Science of Life," by Sylvester Graham, he will find evidence that wholemeal bread eaters suffer little from caries or decay of the teeth. My experience bears out this statement; eaters of wholemeal bread trouble the dentist very little. In Lancaster, where white bread, potatoes, meat, fish, and other foods, poor in bone-forming matter, are largely eaten, there bad teeth are the rule, and dentists plentiful. It is wrong to infer that because men are both bald and toothless, that the baldness is also due to white bread. Teeth are made from the mineral matter in the blood, not so the hairs.

White bread is the cause of many ailments, by being deficient in nitrogenous matters; those who largely depend on it for their nutriment are half starved, and their muscles are poor. After a meal of white bread, a person feels full, but not satisfied, hence arises the craving for strong tea, tobacco, or alcoholic stimulants to overcome these sensations. White bread is deficient in mineral matters, and those who eat largely of it suffer from rickets, if children, and, if adults, from brittle bones, poor teeth, and a blood deficient in saline matter, and scurvy may arise. By white bread being deficient of insoluble matter, it allows the bowels to become costive, hence the bile and other excretory products are reabsorbed into the blood, and cause all kinds of dull feelings, low spirits, depression, want of energy, etc.

The heavily loaded bowel also causes pain in the back, lassitude, weariness, and complaints peculiar to each sex. Hæmorrhoids, varicose veins, and varicose ulcers also arise from constipation, due to the eating of white bread. From the straining necessary to overcome constipation, rupture of a blood-vessel in the brain or lungs may result, and serious consequences ensue. The offal of wheat has constituents for making bone, nerves, and teeth. Magendie proved by experiment that dogs fed on white bread die in six weeks, with all the symptoms of starvation, but others fed on brown bread were none the worse for the monotonous diet. Food reformers do not say that bran contains all the sustaining part of the wheat, but that it is the essential part of the wheat, and should not be thrown to the swine. My own experience has shown me the immense value of wholemeal bread over white. White bread rarely enters our house, and in the Hygienic Hospital, to which I am Physician, white bread is not allowed. All who value their health should make it a rule to eat wholemeal bread rather than white, and they will bless the day on which they made the change.

[The proportion of healthy people who subsist without brown bread is, we should imagine, much greater than those who eat of it. Anyhow, there are thousands of healthy people, who thrive and are happy, without any such form of diet. The nutritive properties of an aliment are not those which the food contains, but those which the system is capable of assimilating. This is our contention respecting brown bread: The digestive organs of nine people out of ten cannot properly deal with it. The one man whose digestive functions can appreciate it, only does so by constant usage, and the good he derives is questionable, since it does not compensate for the harsh treatment to which he has had to submit in cultivating the habit. Beyond this, the constant consumption of brown bread induces an over laxity of the bowels, which, however desirable in some people, is to be deprecated in other cases.—ED.]

SPIDERS.

A contemporary suggests:—Anyone in need of a hobby should try spiders. As there are over 500 species known in Great Britain, it must not be imagined that it is possible to become proficient in this branch of science in a week or two; but for all that is known already of the different kinds and their habits, there is still room for original research, and, by way of recreation, the hobby-rider may verify or improve upon the recorded experiments in the manufacture of spider silk. This matter appears to have been carefully avoided since some enthusiastic Frenchman quarrelled about it, and the only additional information afforded of late upon the subject appears to be an error. It is asserted that spiders' threads may be woven, which is true enough, that they are more glossy and brilliant than those of the silk-worm, which is not supported by the conclusions of those who have compared the two side by side, and that enough of it was once secured for the weaving of a suit of clothes for Louis XIV.

Now stockings have certainly been made from spider silk, and gloves, too, for specimens of each were presented to the Royal Academy of Paris, and to the London Royal Society, in 1710, and there is an indefinite mention of waistcoats being produced from this remarkable fibre. But this is the first that has been heard of an entire suit of clothes furnished by spiders. As it has been calculated that it would be necessary to rear 55,296 of the larger spiders, or 663,552 of the ordinary sort, to yield a pound of silk, we may regard that suit of clothes with some hesitation. It is most probable that it is only a case of slipshod inaccuracy after all, for it is on record that M. Lebon, of Montpelier, sent a pair of gloves made from spiders' silk to that same Louis XIV., and faulty memory, with careless haste, has most likely made a suit of clothes out of them.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

COUNT MATTEI'S REMEDIES.

The world is very slow to adopt new ideas, even if their origin be the amelioration of human pain and woe. Medical history is especially rife with such instances. Surgeons take nothing on faith. They never bestir themselves in matter of investigation, especially if the matter to be investigated does not originate with a member of their own body. Anyhow, such appears to be the experience of Count Mattei, whose electrical remedies have, of late, occasioned no little stir in the world. We can personally offer no opinion about the merits of Count Mattei's preparations, because the Count, for reasons of his own, keeps their constituents a profound secret, and they defy analysis. Far more important testimony, however, than mere analysis could give, is at hand. We refer to the cure of Her Majesty's Ambassador at Vienna, vouched for by his wife, Lady Paget. So impressed was this lady by the efficacy of the remedies, that she has recommended them with beneficent results everywhere. She writes, "During last winter's epidemic of influenza, this medicine acted like magic. Patients from a condition of complete prostration being restored to such complete health in five minutes, that they could hardly believe they had really been ill.

Count Mattei lays claim to the discovery of no occult force. He only maintains that he knows how to make herbal decoctions instinct with potent, vital, electrical force which enables them to work wonders. His materia medica came direct from Nature, through noticing the singular behaviour of his dog which suffered from some form of skin disease, and which invariably took to eating a certain herb when the disease was troublesome. After a course of this canine physic, the patient recovered, and his skin became healthy. Here was an instance of a natural medicine selected by an unerring guide.

At one time, Count Mattei thought he had discovered in this a universal panacea for all diseases. But he found after a while that there were certain patients who did not respond to the medicine. These were people of a sanguine temperament, plethoric, with various heart affections, palpitations, and hæmorrhages. To these he gave a second remedy, which produced most satisfactory results. After a considerable experience of these two main remedies, he came to the conclusion, which he formulated as an axiom, viz., that every disease has its origin, either in the vitiation of the blood or of the lymph, or of both.

Following up his study, he was led to other remedies, and combinations of remedies, suitable to various diseased conditions. Amongst others, Count Mattei prepared five fluids, distilled from plants, which he has found have most extraordinary effects, even when merely placed in contact with the skin. These acted often so instantaneously that he accounted for it by likening their action to that of electricity, and accordingly he named them *Electricities*.

He has formulated the results of his experiments in five principal axioms:—(1) The human organisation is entirely composed of two elementary liquids, the lymph and the blood. (2) On the state of these two liquids health and disease depend. (3) Every disease originates in a change either of the blood or of the lymph, or of both at the same time. (4) Diseases which have the same remedy have a common origin, that is to say, they originate in a vitiation of the same principle, the lymph or the blood. (5) It follows again from all that has been said that the form or localisation of the disease is not sufficient for the selection of the specific remedies, it only serves to distinguish between lymphatic, angioitic, or mixed affections.

SOCIAL SCIENCE.

WOMEN AND WOMEN.

Mrs. Maria F. Salès, the President of the Sydenham Ward of the Woman's Liberal Association, has again favoured us with her views relative to the position we have adopted towards the "Woman Question." We glean from the tenor of Mrs. Salès' letter that she is under the impression that that position is antagonistic to the freedom and general rights of women. This we emphatically disclaim. We are not partisans. The tenor of the article to which our correspondent refers was, moreover, we are pleased to admit, inspired by a woman—a woman of the world and a public woman, to boot. In fact, a woman who has fought her own battle of life. It was, therefore, in no way biassed, by the writer All our views on social questions are studiously impartial to either sex. We think we give ample evidence of this in publishing Mrs. Salès' comments, which, in our opinion, although ably and intelligently advocating woman's cause, ignore the rights of man, even if they do not disparage him. However, let Mrs. Salès speak for herself. But when she has done speaking, we trust our readers will carefully weigh her words—which we regret are not always temperate, just, or true—against the article we published in the interest of both sexes, in our issue of June 18. Our cry is for peace and reconciliation. Mrs. Salès pleads for usurpation and conquest. We leave our readers to judge of the right. *Spectemur agendo*. Mrs. Salès writes:—

"Though I regularly take in your most interesting paper, it was only yesterday I had time to read that for the 18th June last, containing an article on "Women and Women." In regard to this, I was indeed surprised to find in a paper which gives us the freshest of all news in matters of *material* science, an article on '*Social Science*,' which would make one believe that the writer had been asleep for the last thirty years; so ignorant does he seem, that all his old-fashioned theories on the subject of women have been completely exploded by an ever-increasing number of recognised facts made known during that period.

"Were I to reply to this article as thoroughly as I could do, the length of my paper would exclude it from your columns; I must, therefore, confine myself to the few following points of greater importance. First, I will give a few modern proofs that capacity for dealing with state affairs, legislation, political economy, etc., and faculties for excelling in classics, mathematics, art, science, and literature, are no special appendage of the male sex, as this writer would have us believe, but that, on the contrary, there is rather more evidence in favour of woman being the most intellectually capable of the two sexes. To be brief—first as to governing capacity.

"John Stuart Mill (considered our greatest political economist and logician, and a prodigy of classical learning) had his attention first called to woman's suffrage by the fact that women shareholders voted in the Government of India under the Company, and that, directed by this male and female suffrage, the most wonderful commercial conquest the world has ever known was effected. The mutiny would never have occurred had it not been through the jealousy of the exclusively male English Government, not allowing the Company to have a sufficient army of its own, notwithstanding repeated warnings from it of the great danger to which the English in India were thus exposed. Mill also had the opportunity, while at the India Office, of observing that those provinces of India under female sove-

reigns were the best governed.

"Also he tells us in his 'Subjection of Woman' that out of every eight male sovereigns who have reigned in Europe, seven have been weak and incapable, but out of the eight females who have reigned, it was just the reverse, only one was so, and he might have added that in this case, it was not the woman, but her confessor and her husband, who directed her and the persecutions (see Mr. Strickland's 'Life of Mary Tudor'). And yet these women were not 'exceptional,' as many men are stupid enough to remark to me, for they were not picked women, but taken in the ordinary line of succession, just as the kings were. Therefore, there is every reason to suppose that if men had allowed women the chance, there would also have been more capable Prime Ministers and legislators among females than males.

"Let us now turn to Political Economy and Social Science. In the preface to one of J. S. Mill's works, he states that he owes all his best ideas to his wife. Also, has not Mrs. Fawcett done more to simplify Political Economy to beginners than any man?

"Now in regard to capacity for studying law. In France and in Belgium recently, the only two women who have ever presented themselves for the degree of Doctor-in-Law (a degree rarely attained by male barristers) have been successful; and in England the prize (founded, I believe, by Lord Eldon) for the student who should pass the best examination in the most difficult branch of English Law—that of conveyancing—was gained by the first woman who ever made the attempt, over the heads of all the male students. Also Mrs. Weldon showed herself a most able and successful pleader, and that without any special education for it; and out of the few female barristers yet existing in the United States, some are already pleading in the Supreme Court of New York.

"For classics, out of the few women who have the chances of studying at Oxford, Miss Ramsay beat the record of marks of all the men who have passed there, and this, though she had only studied Latin and Greek for about half the number of years male undergraduates usually have done. Again, French statistics show that of the students there who obtain the Government diploma for teaching (without which no French native is allowed to teach anything), a larger proportion of the female candidates succeed than of the males, and this year after year; and yet all men who take up teaching as a calling do so from special taste, while women with no special taste for that line, adopt it as one of the few possible openings for them. I have heard that the same is the case in School Board exams., as between girls and boys.

"In mathematics, Miss Fawcett (one of the few women who have had the chance) beat all male competitors at Cambridge; and Mrs. Somerville, by a mere accident of supplying her husband's place while ill on his ship, was discovered to be a remarkable mathematician and astronomer. In art, though the academies are all shut to women, no man has excelled Rosa Bonheur as a painter of animals.

"In music, though a woman is scarcely ever taught the necessary thorough bass which male students are, Fanny Mendelssohn composed the most beautiful of those pieces published under the name of her brother; and at the opera and the stage some female artistes can earn double the salaries of any males.

"In military science, Joan of Arc (without education) did what no Frenchman could in driving the English out of France; and Miss Ella Carrol, equally without military education, recently obtained a Government pension from the United States Court of Claims for having furnished the plan of campaign to the Minister of War, by which the northern armies marched to victory.

"In medicine, in the Faculty of Paris, a larger proportion of the female candidates pass than of the males. In literature Madame George Sand in France and George Eliot in England are considered by most the greatest novelists, and a woman's novel, 'Uncle Tom's Cabin,' has had the largest circulation of any novel in the world. In oratory, Miss Helen Taylor in England and Mdlle. Deraisme in France are, in the opinion of many, equal to any male orator. Now surely the above list of geniuses (especially considering the artificial disadvantages imposed on women) is sufficient to prove that Nature has fitted woman as well, if not better, than man, to succeed in any and every intellectual career, and that in the interest of humanity all artificial barriers should be broken down before them.

"As to women 'not wanting the vote,' all ascertained facts prove the contrary.

"1st. Not a great town in England which has not seen a demonstration of from 3,000 to 5,000 women claiming the suffrage. The agricultural labours never showed half as much desire for it.

"2nd. The Woman's Liberal Federation delegates voted in favour of it by about 800 to 12 against, last May.

"3rd. In the recent collection of signatures in the *Gentlewoman* there were about 9,000 signatures for, and little over 1,000 against. Thus women who claim the vote are now far too numerous to be considered "eccentric." And this though it should be remembered that slaves in general do not dare to express opinions opposed to their masters.

"As to women 'not using votes when they get them, the facts are all on the other side.

"1st. In Wyoming a larger proportion of the women' vote than of the men (*national* vote).

"2nd. In the Isle of Man Parliamentary vote out of 1,000 enfranchised everyone went to the poll at the first vote.

"3rd. The English municipal vote is as much used by women as men.

"4th. In the last London County Council Election nearly all Liberal women went to the poll. It was only the Conservative women who were selfish, and who have been taught to regard a vote as something dirty, who in large numbers refused to go to the poll, or perhaps, though belonging to Conservative families, they being *women* had too much sense to vote for them. As to this we may boast that women appear unable to be enthusiastic for obstruction to progress.

"Though I could as effectually answer all the minor parts of the article, I dare not occupy more space, but hope I have said enough to show that men who desire to dominate women are no heaven-sent rulers by divine or natural right of authority, but mere vulgar tyrants, who will in time be dethroned like all others. If during the effort to do so, there is a temporary estrangement between the sexes, whose is the fault? Is it with the selfish and conceited tyrants or the too long-suffering slaves?

Our Monthly Edition.

SCIENCE SIFTINGS may now be obtained in Monthly Parts, bound in buff wrappers. Price 6d., or post free, 8d., of any Newsagent; W. H. SMITH & SON'S bookstalls; or of the Publisher, 78, Fleet-street, E.C.

WILD MONKEYS IN EUROPE.

Gibraltar, famous as the strongest fortress in Europe, is the only place on the European continent where monkeys are found in a state of nature. The Barbary ape, of a kind precisely similar to those found on Mount Abyla in Africa, exists in great numbers on the rock of Gibraltar. The natives of Gibraltar, and also the Moors across the Strait, have a tradition that somewhere on the rock there exists a cavern whence a subterranean passage leads under the Strait to the mountains on the other side. The existence of this passage, they say, is known to the monkeys, who regularly use it in passing from one continent to the other. It is much more probable either that the Spaniards brought the monkeys from Africa or that they were brought over by the Moors, and, escaping, multiplied on the mountain, though how such great numbers of them manage to live on a rock which produces nothing but lizards, beetles, and a little grass and cactus is a mystery. They are often seen by the inhabitants, and in fact, serve as a kind of barometer, for when they congregate on the north side of the mountain the indication is of bad weather.

HELPFUL HINTS:

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

CAMERA OBSCURA.

R. GELDERD.—A photographic camera is one form of camera obscura; but the kind usually shown in exhibition grounds, and that, it is to be presumed you wish to make, consists of a conical dark tent surmounted by an optical system capable of throwing an image of the landscape on to a flat surface of white paper, placed horizontally within the tent. You will find no difficulty in setting up the projection table and tent nor in mounting the optical system; but this last can only be *made* by an optician. It consists of a triangular prism with one plain and two curved surfaces, or a flat silvered reflector (to be mounted at an angle of 45 degrees with the vertical) and a meniscus lens, a lens, that is to say, which is convex at one side and concave on the other. The cost of these appliances would not be very heavy, and full instructions for using them would no doubt be given by the optician from whom you obtain them. We would recommend you to apply to Mr. George Airy, 46, Gray's-inn-road, E.C.

MISCELLANEOUS.

E. KENNEDY.—Thanks for your note of 10th inst. We are much interested, personally, in your communications, but regret that want of space prevents us from publishing them. The excessive quantity of interesting matter that is available for publication in SCIENCE SIFTINGS is wholly disproportionate to the space at disposal. We are compelled to exclude all that is not likely to appeal to the taste of the great majority of our readers. However, see p. 186.

M. TROUP.—A good vermicide for the purpose is a solution of 1 oz. corrosive sublimate and 1 oz. hydrochloric acid, in ¾ pint of water. This solution is commonly sold as "bugwash." Chloride of zinc solution, or benzol, poured into the cracks and joints of the woodwork, are also said to be effective.

W. E. S.—You will find a battery of three lenses, folding into vulcanite case, the most convenient and really the best for your purpose. The price may be about 3s. 6d. The box or tripod microscope would not be suitable, but a Coddington lens would answer. The price of one suitable for botanical work would be, we are informed, 4s. 6d. We recommend you to write Mr. George Airy, of Gray's-inn-road.

S. SHEEL and READER.—We have written for prices of the books you require, and expect to publish answers to your letters in our next issue.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers.

PRIZES FOR THE WEEK ENDING JULY 23rd.

The senders of the first twelve letters, opened by us on Monday, July 25th, containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, the 25th instant, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 25th instant. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page i. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors for the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

AWARDS.

Our puzzle continues to attract as much attention as ever, and we have to congratulate 148 competitors on having sent in solutions, included among whom is one reader who has forwarded no less than 60 correct solutions. This lady—for a lady it is—has been duly awarded the prize, and the other prizes have also been remitted.

*** The Coupon will be found on page i.

Authors' Manuscripts
PUBLISHED BY
—— THE ——
GUTENBERG PRESS,
78 Fleet Street, London, E.C.

Edwards' Isochromatic Plates AND Films
Give Truthful Portraits without Retouching.
With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.
"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.
PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.
B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

PATENTS FOR INVENTIONS.—If you have an idea for an invention, patent it for a small cost through Rayner & Co., Registered Patent Agents, 37, Chancery-lane, London. Trade Marks Registered, and Designs secured.
Messrs. Rayner & Co., have a large connection with Manufacturers and Capitalists for the development of Inventions. All particulars and pamphlet of information free.

DOMINION LINE
Royal Mail Steamers to Canada and the United States.
Direct and Shortest Route to America.
LIVERPOOL and BRISTOL
To QUEBEC and MONTREAL (in Summer).
To HALIFAX, PORTLAND, Maine, (in Winter).
Saloon, Second Cabin, and Steerage, at Lowest Rates
For further particulars apply to
FLINN, MAIN, & MONTGOMERY.
24, James St., Liverpool, & 70, Queen Sq., Bristol.

£20 TOBACCONISTS COMMENCING.
Illd. Guide, 229 pages (3d How to open respectably; £20 to £1,000." "TOBACCONISTS' OUTFITTING Co." (Reg.
186, EUSTON ROAD, LONDON.
N.B.—H. Myers' pamphlet on Various Trades post free.
Mgr. Hy. Myers. Est. 1866.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.,* 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, JULY 30, 1892.

SCIENCE NEWS AND NOTES.

"A boy is better unborn than untaught."
—GASCOYNE.

Our Title

has aroused much controversy among our readers. Everyone who has read SCIENCE SIFTINGS wishes his or her friends to do the same, but we are told that our title is not sufficiently attractive, comprehensive, or explanatory to induce people to take up the paper and ascertain its readability for themselves. In short, we are informed by many correspondents that our title is too dry and forbidding for the interesting contents of the paper. Now we are not obstinate or dogmatic—no scientist should ever be so—and we are, therefore, willing to change our name if some one will provide us with a better one. To induce our friends to come to our assistance we will pay any reader one guinea who will send us a suitable title. Write the suggested name boldly on the top of a post card, and your own name and address small, underneath, and forward it to us. The card must contain no other matter. We do not undertake to use any of the suggestions sent in, or even to change our title; but the guinea will be awarded, if a suggestion be adopted. Although we contemplate a change of name our contents will never deteriorate.

We are Face to Face with the Cholera,

and although we have always regarded it as the first duty of a newspaper to use every endeavour to allay public alarm, and thus avoid panic, we consider it would be reprehensible to hide from our readers certain facts that are staring us in the face. Precaution can do much to ward off the threatened danger. Therefore we cannot countenance any foolish attempts to hush up the matter. The Paris correspondent of the *Lancet* reports that "some 200 deaths are supposed to have occurred, and the proportion of deaths is two out of every three cases." It would be reprehensible to wait for anything more serious than this before warning the public, as the dread plague may soon be upon us, and then prevention will be too late.

Prevention is Better than Cure,

and in the case of cholera the odds are two to one against cure. We recommend our readers to see that their houses are in thorough sanitary condition. To shun seaside and country hotels and apartments that are not completely above suspicion. To boil their drinking water and milk. To disinfect everything with a solution made from permanganate of potash. In fact this excellent disinfectant may be universally used. Meat should be washed with it before cooking; it may be taken with drinking water (see SCIENCE SIFTINGS No. 38, p. 159), employed for scouring and cleaning purposes, in the bath, the gargle—in fact, for every domestic purpose. Food that is any way tainted must be shunned, as well as over-ripe fruit. The Continental tour should be abandoned, especially if it lead to France, Switzerland, Italy, or any other country where the sanitary arrangements are defective. Above all, the system must not be allowed to run down. It is to a high physical standard that each individual has to look, should this fell disease find its way to our shores, for personal immunity.

Civilised Man is Threatened

with a toothless future, we are told in a paper by Sir James Crichton Browne, and more recently in a letter addressed to SCIENCE SIFTINGS by Dr. Allinson, if he will persist in eating white bread. We regard these opinions as utterly untenable, and we are pleased to find our views countenanced by Dr. Henry Sewill. He agrees that innate imperfections in the tissues, especially in enamel, form the prime factor in the etiology of dental caries, but he considers that there exists enough evidence to prove that these imperfections are in the main due to evolutionary and hereditary influences. It is ridiculous to suppose that the evolutionary influences can have so effectively done their work in the short period in which whole meal has been practically abandoned for breadmaking purposes. In all civilised races the size and strength of the whole apparatus of mastication — jaws, muscles and teeth—are inferior. Professor Flower showed some years ago, after examination and measurement of many thousands of specimens, that there is gradual diminution in the size of the teeth from the anthropoid apes through the lower races of man to the European. The deterioration of the teeth, if any, is undoubtedly due to other causes than neglecting whole meal. Moreover, it is pointed out by Dr. Sewill that the enamel and dentine when once fully calcified do not undergo processes of waste and repair.

Strict Observation of the Laws of Health

are, of course, necessary to produce good teeth in the nation, and among these laws must be included one insisting upon the use of articles of diet which shall give due exercise to the muscles of mastication and prevent them and the bones to which they are attached from wasting. Such exercise begun early enough, Dr. Sewill tells us, may do good in the individual by stimulating the development of the maxillæ and preventing crowding and irregularity of the teeth—a fruitful cause of decay. Crowding leads to lodgment of débris which fermenting produces acid, the indispensable agent in dental caries. It is not likely that dental surgeons will agree with Dr. Harry Campbell, who in the *Lancet* recommends that children should be encouraged to crack nuts with their teeth in order to exercise their jaws. It is equally ridiculous to suppose that medical men will countenance

the consumption of an indigestible aliment like brown bread for the same purpose. But there is no difficulty in arranging a child's dietary during the whole period of dentition so that digestible articles of food—such as stale crusts and hard biscuits—may be introduced which shall give the masticating apparatus enough work to insure a more vigorous development than is likely to follow the exclusive use of soft bland substances which require no chewing whatever. After the period of dentition such precautions are comparatively valueless. We trust we have given the final blow to the theory that the teeth of posterity will depend upon the consumption by us of a single and hurtful article of diet.

The Physical Insensibility of Women

is a new and pet theory of Professor Lombroso. He declares that the common conjecture that women are more sensitive than men is an opinion that is not confirmed by scientific research. He has made a hundred experiments with the æsthesiometer to measure the sensitiveness of touch in women, and has found it to be in general nearly twice as obtuse as that of men. He has made experiments with the electric algometer on "no less than fifty women" to test general sensibility and sensitiveness to pain, and from the results has decided that women are characterised in general "by a marked degree of sensory obtuseness." He has learned from some of the principal surgeons of Europe that women allow themselves to be operated on with astonishing insensibility. By distinguished dentists he has been told that women undergo dental operations with more facility than men, and do not swoon nearly so frequently in the dentist's chair. He concludes that women suffer less pain than men, both moral and physical, because of their less sensitive nervous organisation, and declares that this hypothesis is the only one that will explain the greater longevity of women.

Striking Originality

always characterises Professor Lombroso's theories, and that he is a painstaking scientist who has opened up new paths of investigation that are leading to great results, there can be no doubt; but in this particular case it seems to us that he has drawn his inferences from insufficient data. The results he has reached by his tests with the æsthesiometer and the algometer must stand as so many facts, and as far as they go they are of value. But fifty tests are not enough to establish a rule. At least a thousand persons would need to be examined in order to make a trustworthy general inference. And even after he had got a result for the Italian race it might not be true for the Anglo-Saxon race or for others. And again, nervous sensibility varies so much in the same person at different times, with different physical conditions, that a test which gives one result to-day may give a very different one a week hence. Our observations have convinced us that women suffer more pain than men. For forty years of life, person for person, the woman suffers three times as much as the man—measure it by pints, quarts, or yards, the proportion will remain the same—three to one. The sensory nerves from all parts of the body to the brain are more open to impressions in women than in men and their nerve centres less firmly tacked down, as it were, and so there is more excitation of the brain in women and a quicker response to outside irritation, and, consequently, more feeling.

The Nervous Systems of Women

are more subject to derangement than are those of men. Nervous diseases are more common among them. But the same parts of the body do not show the same liability to nervous diseases in the two sexes. For instance, neuralgia of the face is much more usual among women, while neuralgia of the leg is more common among men. We have always been educated to believe that women show more moral resistance to pain than men, and make it more a matter of pride to show courage and conceal the fact that a thing hurts. And this is what we always did believe until the experience of a physician reversed our opinion. He has observed, with most medical men, that women care more about being hurt than men do, but that they will not go as long without having a thing that pains them attended to. But when a man comes along who is afraid of being hurt he is a terror—he is worse than any woman.

The Criminal Anthropology of Women

shows some very curious features. It is a fact that in all countries there are fewer convictions for crimes of women than of men. European statistics vary from the highest, 37 per cent. in Scotland, to the lowest, rather less than 6 per cent. in Italy. It is also noted that there is a very wide difference between city and country. The proportion of female criminals is always higher in rural districts, sometimes reaching nearly to that of the males. Various explanations of these facts have been suggested. Some are complimentary to the sex, as that women are not given to intoxicants, nor to gambling, nor to roving; they are more timid, more religious, more tender-hearted, and their sexuality is more passive. There is something in all these reasons, but they do not satisfy Dr. G. Ferrero, who discusses the subject in the *Revue Scientifique*. He points out that the females of the ants, bees, and spiders are particularly cruel, because they are particularly intelligent, and he reaches the ungallant conclusion that the woman of to-day is less criminal because less intelligent than the man. This difference is less in country districts than in cities; and, moreover, in cities a woman can obtain a living at less risk than by criminal acts. Her struggle for life is less desperate; she is less an egotist because she is protected more than men; she is less disturbed by new ideas, because she is slow to perceive them. When she is bad, however, she is "very, very, bad," surpassing men in callous cruelty and absence of pity or remorse. In support of these assertions he cites instances both from history and the courts of criminal procedure.

Electricity Will Do Much for Sanitation

in the near future. The injury done to the public by the discharge of waste products of factories is one which will, sooner or later, have to be seriously considered. It has been suggested that the evil can be readily remedied by the electrical purification of the products. In illustration of the possibilities in this direction is cited the successful treatment by electricity of sewage. The sewage is ordinarily taken miles away to the sewage farm and treated, and the effluent from the farm is expected to be practically pure water, free from all contamination. During its passage from the sewage carriers to the effluent, the water has undergone a process of filtration through the soil into the drains and another process of oxidation. This process is duplicated, with a great saving in time, by electricity. Electrodes are put into the liquid sewage, and large quantities of oxygen are generated. This oxidisable matter is thus brought into contact with free nascent oxygen in a very short space of time, where nature might take days, or even weeks, in the process. The operation is none the worse for being hurried,

and the result is exceedingly satisfactory. It is now asked why this process cannot be applied to the waste liquid products of factories before these waste products are allowed to enter the sewers. If so, instead of passing the waste liquid into the sewers, and thus adding to the contamination of the nearest watercourse, it would doubtless be possible to pass the purified liquid through surface drains, and this would considerably assist the drainage system of towns. The only objection to any scheme of the kind is that manufacturers who hitherto have had no charge for purification of waste would be subjected to such a charge. The restrictions of this nature on manufacturers will become more stringent as the importance of the subject to the public health becomes recognised. That the efficacy of a continuous current of electricity would be perfectly satisfactory for the purposes of purification is certain, and this is another direction where, eventually, central stations will be required to supply a demand.

Archæological Research

is rapidly dispelling the erroneous notions that the early civilisations of the Mediterranean were derived from Asia or Egypt; and that previous to the mythical advent of Cadmus, or the founding of Carthage and Rome, the coasts of this great sea were peopled by savages. In fact, one of the most brilliant periods of commerce and culture on the Mediterranean was about 1500 B.C. At that date there were several centres on the European shore of high civilisation, wholly independent and occidental in their ideals and technique; on the southern shore the Hamitic Libyans and Mauritanians had, by spontaneous development, reached a degree of culture quite up to that of their neighbours, the Egyptians. It is chiefly by the accident that their art-products have been better preserved, that we have hitherto attributed a superior grade of advancement to the latter. There is no reason for believing that the Egyptians were much in advance of the other nations of the Mediterranean basin at the close of the old Empire. The introduction of metals was what chiefly led to the predominant influence of Oriental ideas. This event occurred between 1500 and 1200 B.C. The opinions are now gaining general credence, and it would be easy to support them by abundant evidence.

In South-Western Africa,

among the auriferous reefs of Mashonaland, about 20° south latitude, are found a number of remarkable ruins of well-built stone cities, towers, and forts, which have long been an enigma to archæologists. Needless to say, they were not constructed by any Austafrican people; no negro or negroid race ever built stone walls voluntarily. The problem seems to be solved by the researches of Mr. J. Theodore Bent, which are published in the last number of the Proceedings of the Royal Geographical Society. He visited and explored the ruins of the largest city, called the Great Zimbabwe—this being a word of the local dialect, meaning krall or town.

Excavations Show that These Ruins

were built and occupied by a people engaged in gold-mining. Crucibles and smelting furnaces were found by Mr. Bent, and in the vicinity "millions of tons" of quartz have been worked over for the gold they contained. The stone work is massive, very firm, the stones often carved and decorated, and the sites usually of great strategic strength. Many images of birds, carved in stone, and also many phalli, in the same material, were unearthed. Pottery was abundant, the fragments often decorated with neat designs of animals, plants, and scenes from life. No coins were exhumed, and no inscriptions discovered, except some rude scratchings on a bowl, which resembled Ogham characters. What is significant is the presence in the *débris* of Persian and Chinese Celadon pottery, which is not of very ancient date. Bent's conclusion is that the gold-seekers were Himyarites from southern Arabia, and that their settlements were destroyed by the savage Zenj from Abyssinia about the ninth century of our era. Many consider this to be the Ophir of the Hebrews. An interesting visit to it, not mentioned by Bent, is described in the *Verhandlungen* of the Berlin Anthropological Society for 1889, carried out by a young German named Posselt. Both accounts present engravings of carved stones, figures of birds, etc.; but it is singular that neither explorer could find a single grave or skeleton of this ancient people.

The Silent Language

of the North American Indians referred to in our last issue, anent our ethnological studies at Colonel Cody's wonderful exhibition at Earl's Court, has induced a correspondent to write to us on the subject of Indian dialects generally. He informs us that the Indian language is not permitted now in the Government Indian schools—only English is spoken. So far as religious teaching is concerned, lessons are given in the Bible just as in geography. The Indians have no heads for religious matters. Most of the children are Catholic, so far as they are anything. The Indians, we are informed, are badly in need of missionaries of some kind to teach them better morals. There are certain things, our correspondent continues, which tend to show that Indians are of Jewish origin. The Wichita Indians, it is said, operate on their children in a manner supposed to be exclusively Jewish. Then again, Indians wrap their blankets about them in exactly the same manner as the ancient Hebrews, and the blankets bear some resemblance to the Roman toga. At other times our correspondent thinks that they are of Chinese origin.

The Indian Face

if you look at it just right, very much resembles the Chinese profile, and recently, in Wyoming, the petrified remains of an ancient Chinese war vessel were discovered. It is strange, but an actual fact, that the Manadad (Dakota) Indians use a Welsh dialect. At the present day a Welshman can understand them. It is presumed, and is backed up by tradition, that some Welsh pioneer got stranded among these Indians and taught them their language. In the Indian territory an old Kiowa chief told our informant his theory of the origin of the Indian race. The first man was a Kiowa Indian, of course. How he came to appear on earth does not transpire, but the way he multiplied and replenished the earth with Kiowas was by beating on a hollow log with a stick; males ran out one end and females out of the other. Black Beaver, chief of the Delaware tribe, once told a tradition which no doubt is the Indian account of the arrival of Columbus. A great flood had destroyed all the Indians except the Delawares, and one day there came over the waters a huge bird with great wings, and it carried on its back men with white skins and faces.

VOLUME I. OF "SCIENCE SIFTINGS"
IS NOW READY.
Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.
Or from Messrs. W. H. Smith & Son,
and through any Newsagent.

GLEANINGS OF THE GLOBE.

A STEEL rail lasts, with average wear, about eighteen years.

NITRO-JUTE is a new explosive formed by treating jute with 15 times its weight of the usual nitric and sulphuric acid mixture.

THE cocoon of a well-fed silk worm, it is said, will often yield a thread 1,000 yards, and one has been produced which contained 1295 yards.

THE total number of lung cells possessed by one individual is estimated at 1,144,000,000. The extent of the surface of the membrane lining these cells and tubes in the average human lungs extend over 1,500 square feet.

SOME authorities insist that the great toe ought to project farthest, others that it should not project quite so far as the second toe; while others, again, maintain that the two should be of equal length. It is well known that in antique statues the second toe is usually the longer of the two, while the first is longer in living men.

A SIMPLE appliance has recently been invented for preventing china ware from being broken on board ship by coming in contact with the hooks by which it is suspended. A small piece of indiarubber tubing, closed at one end, is passed over the bent part of the hook, forming a soft cushion, upon which there is no danger of the cup handle being broken.

THE Marquis de Veragua, a descendant of Columbus, will press an electric button fixed in his apartments at Madrid, and the current set in motion, traversing the Atlantic by submarine cable, will start all the machinery at the Chicago Exhibition. Thus, the initial impulse giving life to the great show will be originated from the blood of the discoverer of America.

DURING a recent thunderstorm at Wrexham, hail of unusual form and size fell in great quantities. The pieces were all large, and a large proportion were about three-quarters of an inch long and half an inch diameter, and of a pointy crystallised shape. Some were as if they had been wrenched or screwed off from a block while in a pliable state. These were also equally large, and extremely hard.

OUR offer to give volumes of SCIENCE SIFTINGS to the headmasters of English schools for prize purposes, has been very freely accepted. In fact, we have already distributed over 2,000 volumes. Therefore, we cannot at present see our way to extend this offer to other schools, and those schools that have received a smaller allotment than was applied for, will, we trust, accept our regrets for any disappointment occasioned.

IN the progress of chemistry that nauseous but most useful medicine castor oil has been robbed of its disgusting qualities and converted into an agreeable syrup. It has in fact been born again and baptised with a new name, Palma Christi, or Oleum Ricini Aromaticum. All the cathartic qualities of the drug are retained, but the revolting oily taste is removed, and a sweet spicy flavour substituted, something like a combination of cinnamon and vanilla.

AN inch of rain means a gallon of water spread over every two square feet, or about 100 tons to every acre.

A MONSTER ærolite is reported to have recently fallen into the Caspian Sea off the Apcheron coast where it lies some distance from the shore, and projects 12ft. above the surface of the water, which at this spot is 24ft. deep. The size is estimated at 340 cubic fathoms. The fall of the stone was accompanied by a terrific explosion, which led the inhabitants of the surrounding coast to believe that an earthquake had taken place.

THE jackal is only a little wild dog. Its body is but 14 or 15 inches long, its tail about 10 more, and it stands about 15 inches high. It has all the habits of a dog; when wild it howls, but when tame it barks just like a house dog. It is nocturnal in its habits, but that is because the heat of the climate in Asia and Africa is so great that most animals shun the light, and the jackal does not like the heat any more than other animals do. It is easily tamed and becomes as affectionate and faithful as any dog.

SPIDER ladies are not always kind to their sweethearts. The male is generally much smaller than the female, sometimes to an extraordinary degree, and he is forced to be extremely cautious in making his advances, as the female often carries her coyness to a dangerous pitch. De Geer saw a male spider that "in the midst of his caresses was seized by the object of his attentions, enveloped by her in a web, and then devoured." A sight which, as he adds, filled him with horror and indignation.

IN an early number of SCIENCE SIFTINGS we described a multiple railway system, which is to be a leading feature of the Chicago Exhibition. We now learn that a powerful syndicate has been formed by Col. Cody and Col. Nate Salsbury and some leading English capitalists to promote the enterprise in Great Britain. A combination of Paris bankers has also approved the invention, and proposes to introduce the same in France. This novel American invention promises to revolutionise modern methods of locomotion.

EVERY bee carries his market basket around his hind legs. Any one examining the body of a bee through a microscope will observe that on the hind legs of the creature there is a fringe of stiff hairs on the surface, the hairs approaching each other at the tips so as to form a sort of cage. This is the bee's basket, and into it, after a successful journey, he will cram enough pollen to last him for two or three days. Every one has seen a bee returning home with a little yellow lump on his hind leg, and if the insect is then examined the form of the basket can be easily seen.

DURING the siege of Paris by the Prussians in 1871, a special electric light service was organised for the protection of the city's fortifications from night attack. Foucault arc lamps were used, but as dynamos were not in common use, recourse was had to batteries for the production of current, with one exception. A beacon on the Montmartre redoubt was provided with current from a magneto-electric machine. This beacon, which was doubtless the first search-light used in military operations, enabled those on the redoubt to clearly distinguish objects at Orgemont, six miles away. The Germans tried repeatedly to assail this redoubt, but the electric light proved to be an effective guard.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 39.

157.—What is the so-called blind spot in the eye, and how can its presence be demonstrated ?

The "blind spot" is the base or point of entrance of the optic nerve, constituting a part of the retina that is wholly insensible to luminous impressions falling directly upon it. When both eyes are opened at the same time any object whose image falls upon the insensible spot of one eye is seen by the other. But it might be expected that in these circumstances there should be two dark spots (half illuminated) in every landscape situated in positions corresponding to the "blind spots," about 15° on either side of the point which most particularly attracts our notice. Nature has, however, provided against such a disagreeable result by conferring upon the retina just at the base of the optic nerve, a specially absorbent quality, that enables it virtually to draw upon surrounding parts for an impression of luminosity that itself is incapable of directly receiving. To detect the existence of the blind spot by the method discovered by Mons. Marriott, shut the left eye, and with the right eye look fixedly at the cross marked below,

a	ccc
aaa	c c
a	ccc

holding the paper at a distance of a little over a foot. Now move the paper slowly towards the eye. A point will easily be found at which the image of the square, on the right, ceases to become visible, having fallen upon the "blind spot." But the light *borrowed* from surrounding portions of the retina will cause the square to be apparently replaced by white paper. Were the same marks printed on the cover of SCIENCE SIFTINGS, the right hand mark in this experiment would be apparently replaced by green paper. To detect the blind spot in the left eye, of course the right eye must be closed, and the right hand mark (the square) must be looked at, the cross being, in this case, invisible or visible according to whether the position of the paper does, or does not cause its image to fall upon the blind spot.

158.—What is the best method of diciphering the inscriptions on old worn coins ?

This may be done by merely placing the coin on a red hot iron. The parts where the letters of the inscription had existed oxidate at a different rate from the surrounding parts, so that the letters exhibit their shape, and become legible in consequence of the film of oxide which covers them having a different thickness, and, therefore, reflecting a different "interference colour" from that of the adjacent parts. These iridescent tints thus developed sometimes pass through many orders of brilliant colouration. In some cases the tint left on the trace of the letters is so very faint that it can just be seen, and may be entirely removed by a slight rub of the finger.

159.—How do conjurers produce the effect of fiery sparks issuing from the mouth ?

Having rolled together some flax or hemp so as to form a ball of about the size of a walnut, this is set on fire by the "conjuror," and allowed to burn until it is nearly consumed. Some additional flax is then rolled round it while still burning, the fire being retained in it by this means, for a considerable length of time. At the commencement of an exhibition, such a ball of concealed fire is introduced into the mouth. Air is inhaled through the nostrils, and in the act of exhaling this air sparks are kindled or revived, and may be projected from the mouth without difficulty.

160.—Is it a fact that temporary madness results from eating black henbane ?

Yes. A case was described by Dr. Patouillet of a family of nine persons, who were all driven mad by eating the root of the *hyoscyamus niger*, or black henbane. One of these persons leaped into a pond, and the others gave equally strong evidence of derangement. The phenomena of vision were, in each case, singularly affected. Next day all had recovered their senses, but recollected nothing of what had occurred.

161.—What is the meaning now attached by scientific men to the word elasticity ?

All matter has, in a greater or less degree, what is called elasticity of bulk. All gases and fluids possess it to perfection. Elasticity of bulk is that property by virtue of which the continued application of force is necessary to maintain a change of volume in the elastic body. All solids possess more or less elasticity of shape—the capacity to spring back into the original condition on the removal of a deforming force. But no solid is known to have perfect elasticity of shape; and, of course, liquids and gases are absolutely free from it. These two qualities, sometimes jointly and sometimes severally, are described for shortness by the general term elasticity.

162.—What explanation can be given of the fact that the eyes in painted portraits sometimes appear to follow the movements of an observer ?

The cause of this phenomenon is easily explained. Let us suppose a portrait with its face and its eyes directed straight in front, so as to look at the spectator. Let a straight line be drawn through the tip of the nose and halfway between the eyes, which may be called the middle line. On each side of this middle line there will be the same breadth of head, of cheek, of chin, and of neck, and each iris will be in the middle of the whole of the eye. If the observer now moves to one side the apparent horizontal breadth of every part of the head and face will be diminished, but the parts on each side of the middle line will be diminished equally; and at any position, however oblique, there will be the same breadth of face on each side of the middle line, and the iris will be in the centre of the whole of the eyeball, so that the portrait preserves all the characters of a figure looking at the spectator, and must necessarily do so wherever he stands. This explanation may be illustrated by a picture representing, say three artillerymen each firing a piece of ordnance in parallel directions. Let the gun of the middle one be pointing accurately to the eye of the spectator, so that he sees neither its right side nor its left, nor its upper nor its under side, but directly down its muzzle, so that if there were an opening in the breech he would see through it. In like manner the spectator will see the left side of the gun on his left hand, and the right side of the gun on his right hand. If the spectator now changes his place and takes ever such an oblique position, either

laterally or vertically, he must still see the same thing, because nothing else is presented to his view. The gun of the middle soldier must always point to his eye and the other guns to the right and left of him. They must, therefore, all three seem to move as he moves, and follow his eye in all its changes of place. Such effects are, of course, most remarkable when the apparently moving figures have great breadth in a horizontal plane. They may be indistinct in common portraits owing to the canvas being imperfectly stretched, for the least concavity or convexity entirely deforms the face when the obliquity is considerable.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

169.—What are the sparks due to, and what do they consist of, that result from striking together flint and steel?

170.—Is there any physiological cause, apart from fear, that accounts for such optical delusions as seeing ghosts, spectres, etc. If so, why should these appearances always present the white colour belonging to conventional ghosts?

171.—How can the presence of electrical radiation be detected?

172.—Are large clouds formed in bulk at one time or do they grow by degrees?

173.—What is the object of the differential calculus?

174.—How is the filament of an electric lamp made?

HOW TO EAT FIRE.

There are many other interesting methods of trifling with fire besides those mentioned in the previous column. In placing a lighted substance in the mouth, the performer often uses a piece of oakum, or sponge, saturated with gasoline, which is a highly-volatilised mixture obtained from petroleum. It is placed lighted in the mouth without touching the lips, which are instantly closed, and the fire is at once extinguished. There is a certain amount of moisture, or oily substance, on the tongue, which serves to protect it during the short time the flame is alive in the mouth, which, with the tongue, is also toughened by the use of alum. Paper soaked in alum and water, as is well known, becomes as fire-proof as asbestos.

The gas that is generated in the mouth from the gasoline is utilised by the performer by blowing it into the flame of a lamp through a glass tube, and, as it instantly catches fire, it appears to the observer that the man has an inflammable breath. The flame goes out and re-appears at the will of the performer, as he stops the end of the tube with his tongue, or continues to fill it with gas until the supply in his mouth is exhausted. If the performer puts a lighted wick in his mouth, the wick is saturated with alcohol. His moustache is protected from the flame by being thoroughly soaped.

An interesting fire trick is accomplished with an electrical arrangement, by means of which one of the performers becomes the positive and the other the negative pole of the battery. A spark coil is used, and on whatever part of the body one of them touches the other sparks are emitted therefrom. A very slight shock follows whenever the electric circuit is completed.

A puzzling trick is to make a piece of paper catch fire by apparently only blowing on it. It is done in this way: A small quantity of bisulphate of carbon and a stick of phosphorus are placed in an air-tight bottle with a glass stopper, where the phosphorus dissolves. The paper is soaked in the bottle, and when it is withdrawn has to be used quickly, because when it strikes the air it burns. This trick was put to an amusing use a year or two ago, when a spiritualist was giving an exhibition of "spiritual manifestations." A committee from the audience was invited to come upon the stage and examine the cabinet, and assure the spectators that everything was as represented. It was a very warm day, and the superintendent kindly provided the committee with Japanese fans. He had previously, however, dropped some of the preparation of carbon and phosphorus on the fans, and as soon as the committee began to agitate them, they were naturally astonished to see them burst into flame, and quickly dropped them on the stage. The audience greatly enjoyed their discomfiture.

The same preparation is used with tape paper, which is apparently taken by the performer out of a hat borrowed from the audience. It is rapidly unrolled, and, as it is waved through the air, catches fire. This trick, however, requires a great deal of care and swiftness of execution for its successful performance.

Before licking with the tongue a red-hot bar of iron, or rubbing the lighted end of a cigar or cigarette on the tongue, a solution of borax and alum is used in the mouth of the performer.

A startling trick in the fire line is to jump with bare feet on a hot plate of iron. Before doing this the performer sits with his feet in a tub of ice-water until they are thoroughly benumbed. Then he jumps on the hot iron, but before reflex action sets in, which would, of course, cause intolerable pain, he is off again. The water on his feet turns into steam before reflex action sets in, but, unless there is too much water on them, it affords some protection, otherwise so much steam would generate so quickly as to roast the flesh. We do not advise the trial of this experiment by an amateur showman.

Some conjurors are known as tack and glass swallowers, and actually do swallow these highly indigestible articles, as is shown by the autopsy recently performed on one of them who died with a choice selection of tacks, staples, and broken glass in his stomach. The swallowing is facilitated by a mouthful of water, and the tongue of the performer arranges the tacks in his mouth so that they go down with their heads foremost.

These individuals are usually great drinkers of whiskey, which is said to counteract the injurious effects of the presence of glass in the stomach. After each performance they eat a piece of dry bread, and wash it down with whiskey. The little frogs they swallow make the involuntary descent into the stomach head first, and while they do not remain there long enough to be digested, if the human stomach is capable of such a feat, the frog swallowers claim that no bad effects follow their performances.

In the case of "the strong man with the phenomenal skull," on which stones are broken, the secret of the trick lies in the pad between his skull and the stone, which distributes the force of the blow of the hammer so that he is not injured.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

WAVES OF WATER.

When waves are developed on the surface of water, whether by something thrown into or moving through the water, or by the friction of the wind blowing along the surface, the water constituting the wave rises up and sinks down, but does not move along the surface. When the friction of the wind is the cause of wave production, or when the waves are produced by any other force exerting a pull or a push in the water, there is some horizontal movement or current; but this current is not wave-motion proper, and is entirely distinct from it. The undulations in a slack rope, vibrated at one end, are true wave-motion, analogous to that which occurs on the surface of water.

If we suppose the water to consist of molecules, each having capacity for its own proper motion, and subject to the force exerted by the earth's attraction and by the pressure of other molecules above it, but free to move with comparatively small friction, the formation of waves becomes very simple. Water under the pressure when the formation of waves is possible, is incompressible, and when a solid body is thrown into or moved through the water so rapidly that the displaced particles cannot get out of the way laterally, some of them are forced up, under the well-known law that motion is in the direction of least resistance. If the body is placed in or drawn through the water slowly enough for the displaced particles to push their way horizontally, none of them are thrown up, and the initial wave is not formed. But time is required for this movement, and when the body is thrown into the water, or moved through it rapidly, the displaced particles are forced to rise up against the force of gravitation, the quantity forced up—that is, the size of the initial wave—being determined by the volume of the body and the rapidity of its movement through the water. If the force is impulsive and not constantly acting, the second wave is less than the first, and they go on diminishing until the force is expended in horizontal motion, and there is an elevation of the surface commensurate with the volume of the immersed body—the same result precisely that would have been reached without wave-formation if the body had been immersed slowly enough.

When wind first impinges against the surface of still water, the friction pulls up a little of the water in the form of a minute initial wave, but the force being constantly acting, the wave continues to increase in size until the maximum possible from the given friction is reached.

The force of cohesion between the molecules of water is less than the pull of gravitation upon them, for if this were not the case, water would stand up like a solid mass, as ice does, instead of spreading out and flowing, in obedience to the force of gravitation, and continuing to flow until it reaches some substance in which the force of cohesion is sufficient to counteract the pull of gravitation on its molecules, or until the increased cohesion from congelation accomplishes the same result.

While the force of cohesion between the molecules of water is not sufficient to prevent them from moving in obedience to the force of gravitation, it is still considerable, and very great as compared with the force of cohesion between the molecules of air and other gases; and when a portion of the water is forced up against the force of gravitation, the substance continues in mass, and must so continue until subjected to a force sufficient to overcome both gravitation and cohesion.

When the mass lifted up in the formation of the initial wave falls back (as it must do under the constantly acting force of gravitation), with a velocity too great to be expended in horizontal motion, the molecules receiving this impact must rise up as those did which constituted the initial wave, and so on, each wave being the progenitor of that wave which follows it. If the force is impulsive, as when a body is thrown into the water, each wave is the sole progenitor of the wave following; if the force is constantly acting, like the friction of the wind, each wave in producing another is supplemented by the constantly acting force which caused the initial wave.

When the uplifted water falls back on something not so free to move as the molecules of water—as, for instance, when the water becomes so shallow that the fall is against the bottom, or so thick with grass and water-plants as to impede the free movement of the water—the wave-formation at once begins to diminish and soon ceases entirely. In short, the waves on the surface of the water are the result of the impact of the lifted-up mass falling back on the free-to-move molecules constituting the whole mass with a velocity so great that the force cannot be transmitted horizontally.

In observing the phenomenon on a lake a few miles wide, it is interesting to note that, even in a high wind, the surface of the water near the windward shore is only a little agitated by small ripples; farther out it becomes rougher, and on the lee shore the waves have reached the highest point possible for the extent of surface and force of the wind. The pressure of the wind on the surface of an inland lake is constantly variable, even over comparatively small areas, as everyone has observed who has navigated a sailing boat; and as the friction, which is the wave producing force, varies with the pressure, the waves vary in both length and height.

When the wind is high the crests of the highest waves become unable to withstand the impact of the force, and are broken into fragments or spray, forming what we call "white-caps." This phenomenon does not depend entirely on the violence of the wind, nor on the height and volume of the waves, but it depends on the relation between these two. If the waves are very large and oval (and this depends on the nature and action of the force producing them), only the most violent wind can cause white-caps, while if the waves are small but narrow and sharp, a comparatively light wind will develop them. In a portion of the water broken up in the formation of white-caps not unfrequently the force of cohesion is so far counteracted that the water is carried off in the form of spray; the residue of the white-cap not carried off as spray, instead of sinking down with the main body of the wave as in other cases, flows down the farther side of it. Hence the formation of white-caps tends to diminish rather than to increase the size of the waves.

It sometimes happens that the impact of the wind against the water elevated above the surface becomes so violent that it is all blown away as spray, and no waves are formed at all.

It has not been ascertained experimentally what determines the coefficient of friction of air moving over the surface of water. It is obviously this friction which causes waves in the water when the wind blows, and, like all other friction, it doubtless depends measurably on the direction and violence of the impact. But the air, by a force the operation of which is not clearly understood, and which we call evaporation, is constantly pulling out molecules of water and absorbing them in aqueous vapour.

The units of energy required to transform a pound of water into vapour is a measurable quantity, and according to the law of conservation of energy, the same units of force must be required to do this work, whatever the temperature.

be. The length of time that must elapse in which the work can be done varies with the temperature, but the units of force expended must remain the same. If this is so, the force exerted in evaporation is immense, and its direction, apparently, is from the surface of the water upwards. It must therefore necessarily operate as a resistance when the air moves across the surface of the water at right angles to this direction, and thus increase friction.

It seems to be analogous to friction between two solid bodies when one of them absorbs the particles rubbed off from the other ; the absorption may not increase the friction, but the rubbing-off does. So in this case, the absorption by the air of the molecules or particles of water as aqueous vapour may not increase the friction between the air and the water, but pulling them away from the water certainly ought to do it.

From this it would seem that a dry wind, from its greater capacity to absorb aqueous vapor, ought to produce greater friction and higher waves than a damp wind of the same velocity.

There is another view on the matter which seems to be worthy of examination. If the evaporation-pull when air passes over the surface of a liquid is an element in the resulting friction and consequent wave development, we have, in the capacity of certains oils to resist evaporation, an explanation of the phenomenon that pouring oil on the surface of water diminishes the waves. This is indicated by the fact that kerosene oil, which evaporates rapidly, does not seem to have the effect of diminishing wave formation.

There is another element of resistance which must be taken into account in determinining the friction between wind and water. The air not only absorbs water in the form of aqueous vapour, but the water holds air (or oxygen obtained from it) in solution. This is the air which the fishes breathe, and under atmospheric pressure and near the surface of the water, it is estimated that the air thus held in solution constitutes about one-twentieth of the volume of the fluid. This air can be disengaged from the water. It is this disengagement of the air from the water by the suction of a pump, which renders it impossible for a pump to raise ordinary water to the full height to which the atmospheric pressure will raise a column of water from which air is excluded ; when the suction of the pump exerts a pull on the water with air in solution sufficient to raise it to about twenty-seven feet, the air in the water is disengaged and fills the vacuum chamber, thus stopping the further lifting of the water by the vacuum pull. This disengagement of the air from the water goes on in water-pipes also. In a system of water-pipes the disengaged air collects in the most elevated portions of the pipes, and, unless discharged through air-valves, becomes a serious obstacle to the flow of the water.

It has been demonstrated, experimentally, that when water evaporates into air as aqueous vapour the process goes on by molecule after molecule, and not by aggregations of molecules or masses ; nor that water absorbs oxygen from the air by taking in each molecule separately ; but according to the accepted theory of diffusion of gases, we must assume that the aqueous vapour resulting from evaporation diffuses into the atmosphere by molecules and not by masses ; and the fact that the oxygen of the air dissolved in water is separated from the nitrogen, the molecular constitution of the matter absorbed being different from what it was before its solution, leaves no doubt that that process is molecular also ; the oxygen and nitrogen molecules, whose intermixture, through diffusion, constitute the atmosphere, are disassociated, the water taking into solution a much larger proportion of the oxygen. This could not possibly occur if the process of solution were not molecular. If the air is composed of the molecules of oxygen and molecules of nitrogen so intermixed as to constitute a continuous substance, a process which takes more of the oxygen than it does of the nitrogen is necessarily molecular.

It seems, therefore, that we are authorised to conclude not only that the waves themselves are the result of motion of the molecules constituting the water, and not of masses of such molecules, but that when wind causes the waves, its friction, in part if not entirely, is due to the passage of molecules from one fluid into the other.

COSMETICS.

The art of beautifying the complexion by artificial means is very old. The women of grey antiquity knew how to give their cheeks the rosy hue which nature had denied them. In Ninevah the practice of enamelling was quite common. The skin was made smooth and clear with pumice-stone, and then covered with a layer of white chemical preparations. A toilet-case found in the ruins of Thebes contained a whole arsenal of little bottles full of perfumes and complexion medicines. The custom of painting the face was brought to Gaul and Germany by the Romans. A few centuries later 100 different salves for the complexion were sold in the German market.

In modern times France has been the great manufacturer and consumer of cosmetics. In England, too, the use of them has been general. In 1670 the English Parliament found it expedient to consider a bill to the effect that "all women, without distinction as to age or rank, maidens as well as widows, who should deceive the male subjects of his Majesty and mislead them into marriage by means of paint, salve, beauty water, false teeth, false Spanish wool, corsets or padded hips should be punished under the provisions of the law against sorcery, and the marriage should be declared null." That old law was just too innocent for anything.

It undoubtedly fell into innocuous desuetude when it was found how the miserable old Sir Harcourt Courtleys were deceiving the female subjects of his Majesty with plumpers, wigs, false teeth, dyed moustaches, corsets, and the giddy manners of youth, assumed with great pain in company with the rheumatism of old age. A German statistician, who is said to have accurate data concerning the use of cosmetics throughout the civilised world, estimates that the money which women expend every year for cosmetics would pay for the painting of 27,000 houses at the expense of £15 per house. This is held to be a slander from men of science.

HOW ANCIENT BUILDERS BUILT.

The builders of Babel built well. Tradition relates that it was only a confusion of tongues that checked aspiration. There can be no doubt that the foundations of the celebrated tower that was designed by its architect to reach "heaven" were of the broadest and heaviest sort ; let us say vast walls of the most solid granite, bound and knit together by that most excellent insoluable cement that is one of the lost arts to modern constructionists. Yet if latter day engineers be not hopelessly in error with regard to the conclusions they have drawn as respects ancient masonry from the ruins of ancient structures, ancient builders counted only on the law of gravitation, which they knew in an empiric way, for the safety of the works they wrought.

MARS' MOONS.

In August, astronomers, all the world over, will be actively interested in the observations of Mars and its new-found satellites. Since the discovery of the moons of Mars in 1887, this will be the first opportunity afforded for examining them, inasmuch as they are so small as to be only perceptible at close range. Once in every 15 years Mars reaches it nearest point to the earth. A few weeks hence it will be within 35,000,000 miles of us, whereas it greatest distance is 141,000,000 miles. Great interest attaches to the matter because this sister world is so much like our own in respect to its climatic and other conditions that it may reasonably be supposed to be inhabited, perhaps by human beings.

When the lover swears by earth's "inconstant" satellite it never occurs to him to consider that there are at least 20 moons in the solar system, Saturn alone has eight, the biggest of them, "Titan" being nearly twice the size of our moon, and Jupiter possesses four, ranging in dimensions upward from "Europa," just about as large as the orb of terrestrial night, to "Ganymede," greatest of all known moons. The latter has a diameter of 3,480 miles, whereas the moon belonging to this world is only 2,160 miles through.

Though our moon is supposed to be dead and cold, similar conditions are not assumed to govern all the satellites of the sister planets. Some of those pertaining to Jupiter are believed to emit light of their own, showing that they are still hot. However, astronomers are usually eager to find evidence of life on other spheres, even discovering on the earth's attendant orb apparent traces of mighty works of engineering artifice—the imagined creations of races of beings long extinct—such as the stupendous bridge that appears to span a crater of the moon volcano called "Eudoxus."

Eclipses are every-day affairs on Jupiter. Three of its satellites are eclipsed at every revolution of that mighty globe, so that a spectator there might witness during the Jovian year 4,500 eclipses of moons, and about the same number of eclipses of the sun by moons. Under such conditions one would become accustomed to a phenomenon which occasionally appals the terrestrial observer. The Hindoos, when they see the black disc of the moon advancing over the sun, believe that the latter is being swallowed by a dragon. Then they beat gongs and scream until the frightened monster disgorges his fiery mouthful.

One of Saturn's moons, called Mimas, about half the size of the earth's satellite, is so close to the planet in its circling that it seems to cross the face of the latter at an astonishing rate of speed. Of the seven others, Titan has a diameter of 3,300 miles, Iapetus 1,800, Rhea 1,200, Dione and Tethys each 500, while Enceladus and Hyperion, are very little fellows. Several of them in the sky together, with the flaming ring of star-dust stretched athwart the heavens, must make a gorgeous spectacle on the Saturnian sphere. Through the telescope it is very interesting to watch the shadows thrown upon Jupiter by that giant planet's moons, observation of the eclipses of which furnished the first data for estimating the velocity of light.

Uranus has four little moons—"Ariel," "Umbriel," "Titania" and "Oberon"—which, funnily enough, rise in the north and set in the south. A single diminutive one belonging to Neptune traverses the sky from south west to north east. Neither Mercury nor Venus has any satellite. But the most interesting of all moons are the two that attend Mars, each sixty miles in diameter. That planet is just one-half the size of the earth; its surface is divided into continents and seas, having as much land as water; it has an atmosphere, clouds frequently concealing its face, and its seasons are about the same as here, though the winters are colder. Because one of its moons travels around it three times as fast as Mars himself turns, it appears to rise in the west and set in the east, while the other, really circling in the same direction at a speed comparatively slow, rises in the east and sets in the west. Thus both moons are seen in the heavens at the same time, going opposite ways.

The most remarkable guess on record was made by Dean Swift, who, a century before the moons of Mars were discovered, made Gulliver say of the astronomers of Laputa: "They have found two satellites which revolve about Mars, whereof the innermost is distant from the planet exactly three diameters of the planet; the former revolves in the space of ten hours and the latter in twenty-one and a half hours." In fact, the inner moon is 10,000 miles from Mars, whereas, the diameter of the planet being 4,000 miles, Gulliver's estimate would place it at 12,000 miles. For the outer moon he gives 20,000 miles for the distance, which is really 15,000 miles. The time for revolution for the inner moon is actually seventeen and a half hours and for the outer one thirty hours. These moons have been named "Deimos" and "Phobos," after the attendants of the god Mars, who are mentioned in Homer's "Iliad."

Hundreds of minor planets belonging to the solar system, which are only big enough for moons, though not such, have been discovered during the present century. They are called "asteroids," and the three largest of them are "Vesta," "Ceres," and "Pallas." Many of them are only of about the bigness of a good-sized farm. Life upon one of them, owing to the feebleness of gravity, would seemingly be attended with difficulties. One ingenious romancer has described an imaginary journey through space, in the course of which he landed upon a small asteroid, finding it occupied by a single giant. The latter, being displeased with some remarks made by his visitor, kicked him off into space so far that he fell within the attraction of another sphere.

To solar planets yet undiscovered moons may belong—for example, to the mysterious "big dark sphere" beyond most distant Neptune, which some astronomers assert the existence of. A similar hypothetical world, alleged to have its orbit inside that of Mercury, is "Vulcan." Science has not accepted the latter, though two observers, Swift and Watson, working independently in Colorado a few years ago, simultaneously declared that they saw it. Watson was so confident of his find that he built a tunnel in the side of the hill, pointing toward the supposed new star, with a reflector at the bottom, thinking to see the object better. From the bottom of a well, of course, one can perceive the stars by day with the naked eye. But this enthusiast died without proving his belief. The existence of "Vulcan" and the "trans-Neptunian" sphere has been inferred from otherwise unaccountable perturbations of the known orbs of the solar system.

Many comets which would otherwise pass by into the realm of space beyond are captured by the great outer planets—Jupiter, Saturn, Uranus, and Neptune—and forced to join the family of the sun, becoming what are called "periodic" comets. Those four vast globes are all more or less liquid and gaseous, so that there cannot be any life on them. Of Neptune and Uranus almost nothing is known, because they are so far away, but the two giant orbs, Saturn and Jupiter, are smaller suns not yet quite extinguished. Ages hence they will cool down and be transformed, doubtless into inhabited worlds. There may be

life on Venus and Mercury, though it must be too warm for comfort, inasmuch as Venus is one-third nearer the sun than the earth is, and Mercury is less than half as far away.

A pretty fair notion of sizes and distances in the solar system can be obtained by selecting a level piece of ground where there is plenty of room, placing there a globe 2 feet in diameter to represent the sun. Mercury can then be indicated by a mustard seed 82 feet away, Venus by a pea 142 feet, off, the earth by a slightly bigger pea 215 feet distant, and Mars by a small peppercorn 327 feet away. On the same scale, a moderate-sized orange one-quarter of a mile from the globe will stand for Jupiter, a small orange two-fifths of a mile off for Uranus, and a plum one and a quarter miles distant for Neptune.

The eclipse of the moon of March, 1504, was of great service to Columbus. His fleet was in great need of supplies, which the natives of the Island of Jamaica refused to let him have. Being aware of the phenomenon that was about to happen, he threatened to deprive them of the moon's light, and the arrival of the eclipse so frightened them that they were glad to accede to whatever he chose to demand.

A BEE'S EYES.

The directness of the bee's flight is proverbial. The shortest distance between any two given points is called a bee-line. Many observers think that the immense eyes with which the insect is furnished greatly assist, if they do not entirely account for, the arrowy straightness of its passage through the air. Every bee has two kinds of eyes —the two large compound ones, looking like hemispheres on either side, and the three simple ones which crown the top of the head.

Each compound eye is composed of 3,500 facets—that is to say, an object is reflected 3,500 times on its surface. Every one of these facets is the base of an inverted hexagonal pyramid, whose apex is fixed to the head. Each pyramid may be termed an eye, for each has its own iris and optic nerve. How these insects manage this marvellous number of eyes is not yet known. They are immovable, but mobility is rendered unnecessary because of the great range of vision afforded by the position and number of the facets. They have no lids, but are protected from dust and injury by rows of hairs growing along the lines at the junctions of the facets.

The simple eyes are supposed to have been given the bee to enable it to see above its head when intent upon gathering honey from the cups of flowers. Probably this may be one reason, but it is likely that there are other uses for them not yet ascertained.

A bee flies much in the same way as a pigeon. That is to say, it first takes an upward, spiral flight into the air, and then darts straight for the object in view. Now, an experimenter on insect nature covered a bee's simple eyes with paint, and sent it into the air; instead of darting straight off, after rising, it continued to ascend. Apparently, then these eyes are used in some measure to direct the flight.

Our Monthly Edition.

SCIENCE SIFTINGS may now be obtained in Monthly Parts, bound in buff wrappers. Price 6d., or post free, 8d., of any Newsagent; W. H. SMITH & SON'S bookstalls; or of the Publisher, 78, Fleet-street, E.C.

A COMING GLACIAL PERIOD.

The enunciation by Sir Robert Ball of the fact, which seems to have been first clearly brought to light by him, that of the total amount of heat falling from the sun in a year, upon either the northern or the southern hemisphere, 63 per cent. is received in summer and 37 per cent. in winter, has awakened renewed interest in the problem of the glacial epochs. Dr. Ball's theorem not only strengthens the astronomical explanation of the cause of such epochs, but also adds to its clearness. This explanation may be summed up in a few words.

It must be remarked, to begin with, that the summer and winter here spoken of divide the whole year between them, the equinoctial points marking the lines of division, spring and autumn being merged into the greater seasons. Everybody knows that summer in the northern hemisphere, counting summer as extending in the broader sense just mentioned from the vernal to the autumnal equinox, is about seven days longer than winter. In the southern hemisphere just the opposite condition prevails. This difference arises from the eccentricity of the earth's orbit. If the orbit were a circle instead of an ellipse, winter and summer would be of equal length.

But the elliptical orbit of the earth is not absolutely fixed, either in form or in its position in space. Owing to the varying attractions of the other planets, and more particularly of *Venus* and *Jupiter*, the earth's orbit is alternately rounded up almost into a circle, and then drawn out into a more eccentric ellipse. These changes require vast intervals of time, so that we must go far back into the geological ages in order to obtain evidence of their effects upon the earth. But it is clear, theoretically, that great seasonal vicissitudes must result from such variations in the form of the earth's orbit. When it approaches nearly to a circle, which is its condition now, the difference in the length of summer and winter is small; when it is in its state of greatest eccentricity, the difference is large, amounting under the most favourable circumstances to as much as thirty-three days, or some authorities say even more, instead of seven days, its present amount.

Now the theory in question asserts that the glacial epochs in the history of the earth have occurred during those periods when, the eccentricity of the orbit being large, the difference in the length of summer and winter was at or near a maximum. Such a maximum will, of course, occur whenever the line of equinoxes is perpendicular to the major axis of the orbit. Under such circumstances one hemisphere would have 199 days of winter and 166 days of summer, while the other hemisphere had 166 winter and 199 summer days. But there would be no difference in the distribution of the heat coming from the sun. Just 63 per cent. of it would continue to be received in summer and 37 per cent. in winter in each hemisphere. The hemisphere which had 199 days of winter would have to spread the 37 per cent. of heat belonging to that season over all those 199 days, while the 63 per cent. of summer heat would be concentrated upon the shorter period of 166 days. Accordingly there would be a very long and cold winter, followed by a short and hot summer. The heat of the latter would not suffice to melt away the snow and ice accumulated during the former, and this accumulation would go on until whole continents were buried under a blanket of ice thousands of feet thick. In the other hemisphere there would be, on the contrary, a short, mild winter and a long summer. So glaciation in one hemisphere would be accompanied by genial climatic conditions in the other.

Such is, in brief, the outline of the astronomical theory of the cause of glacial epochs. The plural has been purposely used in describing such epochs, although we commonly hear only one ice age spoken of, because one of the most interesting points about this theory is that while accounting for that age of ice whose handiwork is so familiar to geologists in the northern hemisphere, it also demonstrates that there must have been many glacial epochs of varying intensity in the past, and that there will be many more in the future.

This wonderful thing, the burying of half of North America and the greater part of Europe under ice, and the absolute destruction of all their manifold forms of life, can then happen again, nay, must happen again. Naturally, the question arises, when? A precise answer cannot be given, owing to the intricate nature of the causes at work, but it seems possible to give an approximate answer. Dr. James Croll, in his work on "Climate and Time," has computed the periods of greatest and least eccentricity of the earth's orbit for a million years to come and for a still greater period of time in the past. About 852,000 years ago the eccentricity attained its greatest possible amount. From 240,000 down to 80,000 years ago the orbit continued to be very eccentric, and Dr. Croll's conclusion was that the latest ice age in the northern hemisphere ended with the close of the period of high eccentricity 80,000 years ago.

In the future, according to Dr. Croll's tables, the earth's orbit will become highly eccentric about 150,000 years from the present epoch. Until that time, it appears, we shall be reasonably secure from any invasion of the ice. But the eccentricity then to be attained will be by no means the greatest possible. It will amount, according to Dr. Croll, to 0·0353, as against 0·0168 at present, so that if even a glacial epoch then occurs it will probably not be so severe as some of those that have occurred in past time, or some that may be expected in the future. But there are three future periods of very great eccentricity indicated by Dr. Croll, which will attain their maxima in 800,000, 900,000 and 1,000,000 years respectively from the present time, and when glaciation in its severest form may occur in one hemisphere or the other, or more probably in both alternately. Dr. Croll's estimates of the eccentricity of the earth's orbit at the three dates just mentioned are 0·0639, 0·0659, and 0·0528.

It is interesting to note that during the periods of minimum eccentricity to which Dr. Croll calls attention as separating these three periods of high eccentricity, the orbit will be even less eccentric than it is at the present. The minima will occur in 850,000 years, with the eccentricity at 0·0144, and in 950,000 years, with the eccentricity at 0·0086. But, both the descent from the high eccentricity of 800,000 years hence to the minimum in 850,000, and the subsequent ascent to the maximum in 900,000, are very sharp and steep, and the same is true of the next following minimum and maximum in 950,000 and 1,000,000. In view of these facts one is tempted to speculate as to the chances of recovery that the animal and vegetable forms of the regions afflicted by glaciation during these coming periods of high eccentricity would have in the comparatively few thousand years of respite from the ice that would intervene between the maxima.

It will be observed that while ice ages are unquestionably recurrent phenomena, yet they are not separated by anything like regular intervals of time, simply because the conditions favouring their production do not recur at regular intervals, but are the results of exceedingly complex influences. Moreover, ice ages come in pairs or sets, alternating between the northern and southern hemispheres. This fact arises from the precession of the equinoxes, by which, once in every 10,500 years, an interchange of condition is effected between the hemispheres. At present, for instance, we in the northern hemisphere have our winter when the earth is nearest to the sun, and it is seven days shorter than the summer. In the southern hemisphere, on the other hand, winter occurs when the earth is furthest from the sun, and is seven days longer than the summer. If the eccentricity of the earth's orbit were as great now as it will be 150,000 years from now, and more particularly as it will be 800,000 years hence, the southern hemisphere at present would be suffering from a glacial epoch while we should enjoy short, mild winters and equable summers, longer than those we have now, but not quite so hot. In about 10,500 years, however, a comple interchange will have taken place, and then our hemisphere will have its winters when the earth is furthest from the sun, and its summers when it is nearest. It will hardly be so comfortable in the United States and Europe then as it is in our day, although no glacial invasion is to be expected.

It is because the periods during which the earth's orbit remains greatly eccentric, when once drawn out by planetary attraction, are far longer than 10,500 years, that two or more successive ice ages may occur in each hemisphere during the prevalence of a single period of high eccentricity. If the condition of great eccentricity were a phenomenon of comparatively brief duration, both hemispheres might escape glaciation during such a period, because it might happen that, while the orbit was drawn out into its extreme state of eccentricity, the equinoxes would nearly coincide with the apsides, and so winter and summer would be of equal duration.

As long as no outside influence interferes with the regular procession of the planets, and the astronomer cannot foresee, although he may admit the possibility of such interference, we may count upon our globe remaining a genial abode, neither too hot nor too cold, though subjected to some vicissitudes of climate; and long before the next period of high eccentricity has blasted our fair country with the chilling breath of the glaciers, the race of man may have had its day.

A CHEMICAL EXPERIMENT.

An interesting experiment with chemicals to form the tricolour (red, white, and blue) is sent us by Mr. E. Protheroe Smith, of 18, Harley-street, W. He tell us:—"I dissolved a little mercurio oxide in hydrochloric acid, and added a little potassium oxide, which formed a red precipitate. When the latter had settled to the bottom of the tube, I carefully drew off the liquid without disturbing the red precipitate. I then added a solution of sodium chloride (common salt) and silver nitrate, which formed a dense white precipitate, which I treated in the same way.

"Next I added a solution of cupric sulphate and ammonia, which formed a deep blue colouration and a slight precipitate, and I drew off the superfluous liquid with a small squirt, which prevents the different precipitates from mixing with one another.

"If one does not use a squirt, the tube must be held almost flat, in order that the liquid which is being added should not run down too quick."

TO INVENTORS.—Anyone having a good Invention can, on applying to the Editor, "Science Siftings," obtain the advice and assistance of a well-known Patent Expert, free of charge.

SOCIAL SCIENCE.

TIME AND TIMEKEEPING.

We confess to a special liking for exact people. Time is a great objection to those who are always ahead of time; and a worse objection to those who are after time. Why not in this day of clocks be with time? A great statesman declined to do business with those who robbed him of his time. "Gentlemen," said a railroad superintendent, "you are ten minutes late. If we ran our trains with as little regard to time as we regulate our own movements our road would be ruined. Gentlemen, the mission of railroads is to teach punctuality." The suggestion is correct. The mission of machinery in this industrial age, and, above all, of railroads, is to teach us to make our movements so exact that there can be no collisions. But if any one will not comprehend the necessity of exactitude in the economic regulations of every day life he will surely have collisions. The workings of a newspaper and of press work in general are, next to the railroad, suggestive of promptitude and exactness. We are all learning to move together, act together, achieve in vast companies; and we may define our industrial relations as those of the modern army. Napoleon's drilled squadrons no more wheeled in uniformity than must the armies of peace.

But do you observe how infinite are the numbers of daily collisions in an ordinary life? A family jar or unpleasantness means that two or more of us have failed to come to time; as the homely phrase is, we don't work together. The farmer sometimes finds that he cannot drive two horses together because they don't pull nor step alike; or, as he expresses it, they don't "hitch," and he cannot "hitch" them. It is the same with our marriages, that often two people cannot pull together nor step together, and the whole married life is a series of cross pullings. We believe this as often occurs from a lack of appreciation of time as from any other cause. There certainly is something peculiarly irritating in the habitual procrastination inherent in some dispositions.

Time has grown valuable these later years, and a sharp contrast is brought about with the days of our fathers. The quiet pictures of domesticity are no longer seen when, the haying and harvesting being over, the men of the household had little to do till threshing time. City life has changed even more markedly since the introduction of gas, and public libraries, and night schools, and hundreds of public enterprises, together with railroads traversing our quietest districts. We shall not be able soon to rest at all, unless we learn to move co-operatively and not at cross purposes. Whether some people can be allowed to run their enterprises in such a way as to disturb the rest is now a prominent question. We are agitating to get rid of noises, and it will have to be done. Our nerves will not endure the rasping and friction. Steam whistles and bells as noon calls, or time indicators, were well intended; but they are not needed in this day, when the poorest men carry good watches. There is no reason why one man's business should rend our ears and brains and torture the sick with demoniac screeches and the clangour of bells. Time is in our pockets, and it would easily be in our instincts if we allowed it to get there. So valuable is time that we cannot afford to have our hours for sleep, or for study, or even for eating and digesting, disturbed by the noises of others. So it comes about we are getting adjusted to each other as fast as possible. We shall soon have silent pavements everywhere; and the bells will go; and the railroads must make less bluster and blow. After awhile we shall get by the jangle of the new era of steam into the electrical era; and that means we shall get out of the era of noise into the age of quiet.

We shall get time into our instincts. It is there to some extent now, and only the errors of civilisation have blunted it. We are never so wholly instinctive as when asleep, and then we know time absolutely. No one needs a watch to tell him it is 4 o'clock and train time. Impress it well on your brain that you are to be up at 2 or at 5, and you will drop your dreams and waken to the minute. The reason is that when awake we argue about the o'clock, but when asleep we do not go to clocks and sun-dials, but to nature. A savage needs no time indicator, or at least is far less dependent than we are. He knows time as he knows place, directly and immediately. The consciousness of animals is of the same sort—it is direct knowledge, not the result of logic. Dogs and horses and fowls show it in notable degrees. A cow will stop chewing her cud at a given moment, and rise up for her next meal. If the barn boy be not on hand within five minutes of the hour she is restless. A horse excretes at certain spots on the road, showing an unconscious knowledge of place; and by similar indications recognises time. Birds and fowls recognise hours for meals, and for going to roost, and for special rambles.

Times for migration are also in the instinct of animals and birds. There is nothing apparent in the season to indicate to them the hour for migrating. This animal perception, keen in the savage, is less keen in races that are not compelled to use it. We have lost much, as we have gained much, by our arts and conveniences. Our memories are not as good in some directions as were the memories of the troubadours. Our senses of time and place are badly encroached upon by our hour-glasses, sun-dials, and clocks. But there is no question that we may recover any power we have lost. Civilisation has by no means become ripe. There never has yet been a completed civilisation. Every one has fallen before reaching its aims. The end of true civilisation must be, of course, perfected manhood in a perfected citizenship. Our staffs and crutches in such a state may be thrown away. A watch is an implement for an incomplete psychological development.

The time sense of the domestic animals is apparent to every one. Now, if we go to the very oldest race known—the descendants of the Cave Dwellers—we shall see the sense of time is not much unlike that of the dog, horse and cat. The Esquimaux, to whom we refer, have no words to distinguish distant time. They distinguish to-day, to-morrow and yesterday, but day before yesterday and day after to-morrow are the same. Beyond that, in either direction, they have only one phrase, that is "some time ago," and for distant time they only can say "long ago" and "by and by." They have no dates in their past and future. Here is clearly the animal instinct or sensation slightly enlarged and made more definite with words. Man's first step of importance away from the beast seems to have been his observation of the moon and stars. The Esquimaux associated each moon with a specific work, which is really no more than the birds do in a general way.

Progress from this exceedingly simple conception of time to the complex calculations of later and higher races has been wholly away from the natural to the artificial. We reckon the tenth of seconds as we run our cosmology back millions of years by accurate data, and forecast the future with equal precision. To retain our acquired powers and regain the lost is not impossible. We must even consider the possibility of turning over to instinct very much that now stands in the category of calculation. This is a curious,

and, when we carefully consider it, the chief marvel in man's evolution. We mean the fact that what we do in one generation only by aid of figures, and dials, and artificial help of other sorts, we by and by get at without effort. The Hottentot labours to count five; our babes can distinguish five at a glance. As soon as we have well-mastered a difficult process, and repeated it for a few generations, it passes over into instinct, and we do by direct knowledge what we did by severe calculation. In this way we are born mathematicians and born time-keepers. A man is himself a clock, full of time indications.

It is time to retrace our steps to our earlier proposition—we do it instinctively—that time has grown vastly more valuable these latter years. If you ask a man why he dislikes to die he will be sure to answer because he has so much to do, or that he has planned to do, and he dislikes to leave it undone. We are desirous to clean up our work. This is a just estimate of our average modern life. We feel in us the crowd and pressure of the industrial age. Other nations have had their sleep periods, and we shall doubtless have ours. Nations sleep as individuals sleep. The Chinese are just waking from somnolency. Other peoples die while asleep. It is doubtful if the Greeks can ever quite get their eyes open again and have sufficient autonomy left to be a nation. For a long while, at least, our mission is to go forward. There will be no rest for us for another century. The twentieth century has work mapped out ahead of it that will tax its energies to the utmost. But as cycles of development complete themselves historically in about 500 years, it is more than probable that we shall reach an equilibrium of sentiment and effort by the end of another hundred years. But with all our rushing and hurry, do we really come any nearer gratifying and satisfying our sense of achievement? The field open before us is now so limitless that there is a sense always of having made half a failure. Longfellow complained of being unable to do what he desired, and what he considered a reasonable amount of work.

Health and work, or accomplishment, depend on our recognition of time. Make the best of us, and we are creatures of habit. Break up natural habits and create artificial at your own risk. You cannot often repeat the process without a break up of the physical machinery. This law of sound existence should be understood. We cannot tamper with time. Born in us are demands regulated to the seasons and hours, and we cannot readjust ourselves to any great extent. No one can live long without a regulated quantity of sleep taken at specific hours. The demand is an unconscious one. We do not will to go to sleep; we simply go to sleep. It is dangerous to will to the contrary until the habit is broken.

What proportion of time may one fairly take from a neighbour or friend? We lack the common sense custom of denying to any one the privilege of taking from us time more freely than money. Bulwer, in his "Coming Race," shows a picture in which time has its just estimate. Will society not soon be recast in this respect, so that any one may, without offence, dismiss a visitor? Really good society already recognises such a right. We have, however, barnacles who prefer abuse to being broken from their moorings in our busy hours. We know authors who literally secrete themselves from their families when occupied with a volume, and are thus lost for weeks or months. A noted man becomes at once a victim of curiosity. All sorts of idlers pick the lock of his privacy. His name is needed for both valueless and valuable enterprises. He is under a new law, that which requires him as past compensation for his popularity to give of his time to the public. No one really owns his own time. Our social obligations precede our individual claims. But there is a just limit to this kind of benevolence. We must often rise up with resolution and declare that we will not allow others to use that time which we need for recuperation and development, for health and soundness of moral living.

We are inclined to place foremost among all the social virtues the aim to be timely. Certainly it is an admirable act, worth much effort to attain, to be always exact in our duties. We have no more right to pluck time away from a friend than to rob him of his money or clothes.

THE SCIENCE AND ART OF GOVERNMENT.

Government should be looked upon as the business agency of the nation, and the science and art of government are the science and art of conducting this business agency. The various branches of administration have arisen through pressure from without. Everything that the people have demanded to be done with sufficient unanimity and persistence has been eventually undertaken by the Government. One public office after another has been created by law, placed in charge of proper officers, and conducted to the best of the latter's ability. Most offices have grown and expanded in their scope and usefulness. Many have been several times reorganised and the service perfected.

Although the various systems of administrative operation have been largely empirical, devised by men who had little preliminary preparation for the work, improved through the growth and demands of the service, and brought to perfection by thoughtful study of the needs of the public in each individual case, still the whole rests on a rational basis and constitutes a great system of government. The general laws and principles underlying this system constitute the science of government. The carrying out of these laws and principles is the art of government, and although, as in the case of almost all the practical arts, it was empirically developed, there is no reason to doubt that it will be as greatly improved and perfected by its reduction to a science and its enlightened prosecution as such as all the other great industrial arts have been since science has been applied to them.

Among the most promising sources of advantage in the scientific method is the comparative study of government operations. While, from a very broad point of view, all government is the same, when viewed at in detail the greatest individual differences are found. Much of this diversity grows out of the natural differences in the conditions of nations, but fully as much is due to the differences in the methods adopted to accomplish the same purpose. Amid all these varying methods there must be great differences in their efficiency. Some are coarse and clumsy, while others are precise and refined. There are all the grades that exist in the manifold mechanical devices of the other arts, those which are best being always those which have most thoroughly utilised natural forces, including the social forces.

The scientific study of government would make the comparative study of methods a leading feature, with a view to the recommendation of those which under all circumstances are the very best. This is only one out of any required number of illustrations that might be given of the superiority of the scientific method in government.

In the science of political economy the subject of government operations is destined to occupy an increasingly prominent place. It is safe to say that no chair of political economy in any institution of learning has ever taught or

attempted to teach the practical workings of public administration—the way in which the business of a nation is conducted. It is impossible to teach this branch of political economy without the means of a direct examination of the different systems of government business as they are conducted by their respective bureaus. Each great system, such as those of finance, land, patents, etc., would require a course of lectures, with repeated visits to the departments, inspection of records, books, papers, merchandise, etc. This would require a legal right to prosecute the study in this only practicable way. Nothing short of a national institution, created and authorised by law to teach the science and art of government, could successfully carry out this scheme of education. As a safeguard to our institutions, not less than as a means of national progress and enlightenment, no other educational scheme is equal to it in importance.

HELPFUL HINTS.

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

PARALLELOGRAM OF FORCES.

J. P. TAYLOR.—This is a very usual geometrical method or estimating the combined or resultant effect of any two forces acting on a body that is perfectly free to respond to the conjoint action of those forces. Mark a point on a sheet of paper to represent the original position of the body while at rest. Draw from this point two straight lines in directions corresponding to the directions in which the two forces respectively act. Mark off on these lines two points A and B, having their distances from the point of intersection proportional to the magnitude of the respective forces. Now complete the parallelogram by lines drawn from A and B. Draw a diagonal of the parallelogram joining the point where the last mentioned lines intersect one another with the point where the original lines representing the applied forces join one another. This diagonal will coincide with the direction of the resultant force, and will be proportional to it in magnitude in the same sense as that in which the first-named lines were made proportional to the applied forces.

MISCELLANEOUS.

PARABOLA.—We have pleasure in acknowledging receipt of your two communications, which have been placed in the hands of the astronomical editor on the staff of SCIENCE SIFTINGS for consideration.

C. A. BOULTER.—The precise chemical constitution of living protoplasm has not yet been determined. Query No. 150 was replied to by an authority on medical science, and we think the statement published was about as complete as possible within reasonable limits of space.

FRIEND OF SCIENCE.—Your suggestion commends itself to us; something of a very similar character having already been under our consideration. We may probably take some steps in the matter very shortly, and, in the meantime, would be glad to have your name and address.

S. C. REDMAN.—We much regret being unable to supply any reliable measurements of Deeming's skull. Our agent in Melbourne reports that it was very ordinary looking.

J. B. GARRAD.—The atmosphere of Mars is stated to be a very sultry one, and we regret, therefore, the conclusion to which you have been led that your deceased friend was translated thither. His proposition, while in the flesh, to signal Mars by means of flash lights in the Desert of Sahara was ingenious. And your suggestion that the markings quite recently observed upon the Martian sphere may indicate attempts on his part to attract our notice is most striking. The views you advance are interesting, and seriously worth consideration, but we fear that they can never advance much beyond the theoretical stage. Read a paragraph headed "The Four Thousand Pounds' Prize" in SCIENCE SIFTINGS for June 11 last.

E. J. COOPER.—We regret that we cannot see our way to accede to your request. In fact, what you relate of the other journals has occurred also in the case of SCIENCE SIFTINGS. Flat earth theories were kicked out of our columns some considerable time since. We have abundance of new matter at command that is both interesting and *accurate*.

R. W. GREEN, JUN., and others, will be replied to in our next.

GEORGE KNIGHT (Hull).—Many thanks for your interesting communication, but the incident you note has already been published.

PRO BONO PUBLICO.—Thanks for your letter. Your views on the brown bread question are interesting. The exception proves the rule. One of our rules is, by the way, to disregard all communications not authenticated by the name and address of the writer.

THOMAS EVANS.—We are obliged to you for the suggestion, and will adopt it. Wish you success in the competition.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)
The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers.

PRIZES FOR THE WEEK ENDING JULY 30th.

The senders of the first twelve letters, opened by us on Tuesday, August 2nd containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Tuesday, the 2nd proximo, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 2nd proximo. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page i. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors or the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

AWARDS.

We have received 112 solutions for the current week. The largest number sent in by one competitor being 24. We have duly forwarded the awards to the successful competitors.

*** The Coupon will be found on page i.

NEWMAN & GUARDIA'S
NEW CHANGING BAG AND CARRIERS. FOR PLATES AND FILMS.
A perfect changing-box is at last offered to the public, greatly reduced in size and weight, with new and improved mechanism, and an Index showing number of exposures. Full Descriptive Price List, post free on application.
NEWMAN AND GUARDIA, Manufacturers of Scientific Apparatus,
71, FARRINGDON ROAD, LONDON, E.C.

Edwards' Isochromatic Plates AND Films
Give Truthful Portraits without Retouching.
With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.
"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.
PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.
B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.,* 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, AUGUST 6, 1892.

SCIENCE NEWS AND NOTES.

"But words are things, and a small drop of ink,
Falling like due upon a thought, produces
That which makes thousands, perhaps millions, think."
—BYRON.

Eighty Suggestions for Our New Title

have reached us up to date. We must, however, decline to express any opinion about their merits as yet, and in case any reader of SCIENCE SIFTINGS has not seen the offer made in the last issue, we repeat that we will give one guinea to anyone sending us an acceptable idea for a new title to replace our present one. The name suggested must convey the essence of the contents of the paper and give a notion of their popular form. The paper deals with every subject that can possibly affect the welfare of mankind in science, medicine, food, health, literature, sociology, machinery, manufactures, and mechanics. All this the new name must convey to a casual hearer. Write your proposal boldly at the top of a post card and your name underneath; then mail the card to us. That is all you have to do. We will do the sifting.

To Insure Good Health,

an abundance of oxygen and pure water is an absolute necessity. There are no purifying agents for the blood like pure air and pure water. Oxygen is a general house cleaner, it saturates the blood, and thus reaches every part of the system, while water is just as good and necessary for cleansing the tissues on the inside of the body as it is for keeping the outside of the body clean. In fact one medical man has written to the effect that the notion that many people have of purifying the blood by putting something into it is absurd—as though impure substances could have any purifying effect. Let one with blue lips and pallid face start out briskly for a run, and in a short time he comes in with rosy lips, bright eyes, and an altogether different countenance. The oxygen which he has been taking in has served to wash out the effete matter and burn it up, and he is a new man. Then, take plenty of exercise in the open air, live in well-ventilated rooms, eat simple, wholesome food, and drink freely of pure water, and you will need no other blood purifier.

The Tobacco Habit

has been so frequently reprehended in these columns that several correspondents have written to inquire if we condemn it entirely. We may at once say that we do not. Although in excess the use of tobacco tends to depress the vital force, in moderation, men who have to go through a certain amount of mental strain are the better for it. It exercises a soothing effect on the overwrought nervous system, and brushes away the cobwebs and makes man a more sociable animal. Men who lead sedentary lives secrete a far greater quantity of gastric juice than their more active brethren, with the consequence that they evince a proportionately greater craving for food. Tobacco calms this nervous excitement, and saves the sedentary smoker from overloading his stomach with material he cannot dispose of or assimilate, and which, therefore, is absolute poison to his system.

House Flies are Not Usually Regarded as Dangerous,

but at the same time there have been several disagreeable accidents of late following the bites of insects that are not in themselves poisonous. Besides, flies undoubtedly carry contagion from one house to another, and it is, therefore, advisable at this time of the year for every housekeeper to be well armed with fly papers. In the case of invalids a simple and unobjectionable plan is the suspension of a glutinous cord above the head of the patient. It is also a fact familiar to bee-keepers that the sting of the bee varies in severity under different conditions. May this not be likewise attributable to the previous surroundings of the insect? We may also glean from the fact an implied lesson as to household cleanliness, and the *Lancet* advises the treatment by suction, poultices, or other convenient methods even so slight a matter as an irritable fly bite.

Cinnamon is Another Disinfectant,

the properties of which certainly equal those of permanganate of potash, referred to in these columns last week, if we may rely on the description of its virtues published by M. Chamberland, a worker in M. Pasteur's laboratory. This investigator says that no living disease germs can resist for more than a few hours the antiseptic power of essence of cinnamon. He regards it as quite equal to corrosive sublimate—mercuric bichloride—in its destructive action on microbes. Where fever or cholera is rife, a decoction of cinnamon would be very effective, whereas the effects of drinking corrosive sublimate need not be particularised. So that our ancestors were not so far deceived when they took strong doses of cinnamon in their mulled wines.

Concerning the Emotions

of hate, fear, disdain, scorn, anger, and horror, usually represented by facial expression, and in regard to their origin, influence, source, and expression it has been noted in all ages that emotion possesses a natural language in expression. The medium conveying our inward feelings to our fellow-creatures—the frown of anger, the quiver of fear, the anguish of suffering, the glances of tenderness—are in complete accord with the state of feelings possessing the individual. The manner of expression, both facial and physical, is of great importance in our welfare, for not only does it give force to spoken words, but the free expression of

outward signs intensifies language and lends an additional charm. The force of inanimate nature is oftentimes rendered attractive by an imaginative process. The sun, moon, wind, and rivers, are less engaging when viewed merely as physical agencies than when they are supposed to operate by human motives, purposes, loves, and hates. In regard to the central seat of the emotions, some interesting experiments have recently been made by Dr. Courmont, of Lyons, France, in which he ascertained beyond a reasonable doubt that the cerebrum, or brain, is a centre for the registration of certain impressions, and is also the organ of various psychical manifestations. The cerebrum is also the seat of the higher mental faculties and the organ of sense, while the cerebellum, or lesser brain, is the seat of unreasoning faculties, as love, hate, joy, and sorrow, or the organ of sentiment.

Truant Electricity

is responsible in the large American cities, where electric lighting is far more the vogue than here, for a large number of casualties. Horses and men were almost daily, at one time, struck dead in their tracks by the perverted energy of electricity. Things are a little better in the States now, but we Londoners appear to be threatened with the same danger. In Walbrook a few days since, through some unexplained failure of the insulator of an electric lighting main, a metal shop front became charged with wandering electricity, and passers-by discovered that by touching it with their hands they could experience the delightful inconvenience of an electric shock. The circumstance that this luxury is in the minds of most people, and particularly of most street urchins, associated with festival occasions and penny fees no doubt invested the unpriced supply in Walbrook with an added charm. Happily, the amount of current obtainable seems to have been inconsiderably small; but seeing that a metal shop front in connection with an electric lighting main might easily become a greater source of peril to unwary passers-by than an uncaged tiger, the story of this mishap is calculated to give the reader of a serious turn more food for reflection than is altogether pleasant. Fortunately, it is not possible that such an accident should happen without serious fault on somebody's part, and although the London public seems to have taken the matter with a light heart, we hope, with our contemporary the *Lancet*, that those whom it most nearly concerns will make a point of exacting the full penalty for a flagrant default, be it whose it may—*pour encourager les autres*.

The Sunniest Spots in the Kingdom

are the Channel Islands, which enjoy sunshine during 39·9 per cent. of the time the sun is above the horizon in the course of the year. Falmouth shows the next highest record, 35·7 per cent., and along the whole coast of England, from Milford Haven to Yarmouth, there is no great variation. The coast naturally receives more sun than inland districts, where clouds are formed by the hills, and in towns the percentage is low owing to the smoke. As regards the monthly means, it is found that in Jersey alone does the sunshine ever attain to half the amount possible; 52 to 55 per cent. is the average value. Geldeston, in Norfolk, follows with 48 per cent., and the eastern coast, as far north as Aberdeen, is decidedly sunny. Ireland and the west of Scotland have persistently cloudy skies in summer and early autumn, but in late autumn Ireland is particularly favoured by the sun. On the other hand, from some unexplained cause, there is a deficiency of sunshine in Jersey during November. The sunniest month in the ten years was May, 1882, when thirty-three stations registered at least 50 per cent. June, July, and August, 1887, were also very bright. The highest monthly amount entered, 68 per cent., was recorded at Falmouth in June, and in Jersey in August of that year.

The Sea Shore Sands

are vastly more durable than the seemingly more resisting pebbles. Pebbles wear out rapidly. Scarcely any, even the hardest, can stand a year of steady thrashing on the shore, but these sands endure for ages. The reasons for this are simple. In the first place, each grain of sand is an admirable illustration of the survival of the fittest. If it be not perfectly coherent and very hard, it will not be carried far before its weakness is found out, and it is broken into mud on the pebble beaches, where it is generally made and borne away by the sea to the deeper water. Then, because of their smallness, the grains lie with so little interspaces between them that they hold the water next their faces by capillary attraction.

When a Wave Strikes the Shore

the grains of sand are pounded together, but they do not touch each other. If we press on the wet sand with the foot we see that the mass whitens as the pressure is applied, and a part of the interstitial water is poured out; take the foot away, and the water returns to the crevices between the grains. Only dry sand will rub grain against grain and give the audible sound which, when it is sharp and clear, is called singing. No beach will thus crack or sing beneath the foot when it is wet. This curious endurance of rocky matter, in its comminuted form, of the erosive force of the sea makes the sand the natural protector of the land against the fierce assaults of the sea. If sand were easily pulverised, if it were readily floated away, if it had, indeed, any other than its actual assemblage of properties, it is doubtful if the lands could have made good their place in the contest with the ocean. These doughty little champions have certainly kept for our use empires which, but for their good works, would long ago have vanished beneath the waves.

A Method of Measuring Water,

which is extremely ingenious, has been adopted by Prof. F. J. Smith. About two years ago he wished to know from time to time the rate at which a river was rising after a fall of rain. The river was at a considerable distance from the spot where its height was to be known, but by means of the combination of two organ pipes and a telephonic circle he was able to make the required measurement within rather close limits. At the river station, an organ pipe was fixed vertically in an inverted position, so that the water in the river acted as a stopper to the pipe, and the rise or fall of the water determined the note it gave, when blown by a small bellows driven by a very small water wheel. A microphone was attached to the upper end of the organ pipe; this was in circuit with a wire leading to a town station at some distance; at the town station there was an exactly similar organ pipe, which could be lowered into a vessel full of water while it was sounding. By means of the telephone the note given by the pipe at the river was clearly heard at the town station; then the organ pipe at this station was lowered or raised by hand until it gave the same note. The lengths of the organ pipes under water at the two stations were then equal, so that the height of the water in the distant river was known. The determination can be made in

less than a minute by any one who can recognise the agreement of two similar notes. The arrangement when first tested was so placed that the height of water at two places near together might be easily compared. A lad with an average ear for musical sounds was able to get the two heights to agree within one-eighth of an inch of each other, while a person with an educated ear adjusted the instrument immediately to almost exact agreement. The total height to be measured was 17 inches. A difference of temperature at the two stations would make a small difference in the observed heights. For example, taking a note caused by 250 vibrations per second, a difference of 10°C. between the temperatures of the two stations (one not likely to occur) would make a difference of about 0·02 in the height, a quantity of no moment in such a class of measurements.

The Farmer Claims the Bacillus

as his dearest friend since Herr Loeffler's discovery that the microbe may be utilised for the extinction of mice. The professor made his experiment in Thessaly during a fearful plague of the vermin, in the course of which an entire field of corn was sometimes destroyed in a night; even the harvest being at one time endangered. The bacillus *typhi-murium* had been shown to be poisonous for mice of the species Arvicola Arvalis, and the field mice in question belonged to an allied species. Preliminary experiment showed that the bacillus was fatal to these also. It was further found that the animals ate readily bread impregnated with fluid containing the organisms, and, though well supplied with suitable food, consumed portions of the bodies of their fellow mice which had succumbed. The bacillus grows well upon a decoction of oats or barley, to which peptone (1 per cent.) and grape sugar (½ per cent.) have been added. Culture fluid of this composition was made in quantity, and tubes of agar containing pure cultures of the bacillus were prepared. The practical measures adopted against the plague were as follows: In the first place it was proved that the bacillus was harmless to all the domestic animals kept in the affected districts, and to man. A quantity of culture medium was poured into a vessel, and to this the contents of some of the agar tubes were added. Peasants were caused to come in from the affected districts, each bringing a basket of broken bread. The bread was soaked in the inoculated fluid, and the men dismissed, with instructions to place in each mouse hole a portion of bread. As a further measure, numbers of mice were inoculated subcutaneously with pure culture of the bacillus, and then set free. Within nine days a notable decrease in the ravages caused by the mice was observed.

A Curious Phenomenon

in connection with albino animals has just been observed. On the reopening of an old mine near Bangor, California, one of the hands made the discovery that the place was infested with albino flies. He caught one, and found it was absolutely white, with the exception of its eyes, which were red and unusually large and prominent. Scarcely had the explorer recovered from his surprise at the white flies, when he was startled by the whirring sound of a rattlesnake's tail. Looking carefully around, he saw the eyes of the reptile, and threw a rock in the direction of them. The rattling promptly ceased, and a mass of white, glistening convolutions writhed into view from behind a protruding boulder. A couple more rocks despatched the reptile, which proved to be a rattler over 4 ft. in length. The colour was also pure white. But the most remarkable fact in connection with the flies was that, after exposure to the light for a week, they resumed the colours of ordinary house flies.

Whence the Whiteness of these Albinos?

for we can hardly assume that the change of colour in the flies and the snake was due to the same cause as that which produces the true albino. Buffon asserted that the primitive colour of every living thing in nature was white, or, to speak more correctly, that every living thing in nature was primitively colourless, and that development of colour was sequential to changes gradually induced by varieties of conditions to which things of life have been subjected in the course of ages. The after-suggestion of Blumenbach that the peculiar colour of the eyes of albinos is due to the absence of the black pigment, exploded the hypothesis of Buffon, and afterwards led to the view generally accepted that the white colour of the skin is brought about by a similar cause, and that the loss of colouring substance is induced by a gradual and hereditary process of change. In this last record the change in the snake seems to have been direct, while in the case of the flies there was the rapid development of dark colour so soon as the influence of the sun was brought into play, as if the sun's ray had developed at once a pigmentary or colouring substance. The observations, we are reminded by the *Lancet*, open up a new line of investigation for those who are devoted to the study of the influence of external forces on living structures and of adaptability to circumstances as part of the varied manifestations of vital phenomena that must be ever in progress in our universe.

Exploring the Interior of Australia

is beset with so many difficulties that since the failure of the party led by David Lindsay, no other attempt has been contemplated. In some regions through which Lindsay had to pass not a drop of water has fallen in two years. It should not be inferred, however, that all these inland regions are permanently unfit for human enterprises. Lindsay saw them last when they were suffering from an unusually prolonged period of drought but much of this region needs only rain to vivify it. Natives inhabit certain districts, and Lindsay saw them drawing their water supply from the roots of small trees called the mallee tree. He says they can tell by the appearance of the trees which will yield a supply of pure water. Mr. Charles Chewings and other authorities assert that immense expanses of inner Australia, once believed to be nothing but useless desert, contain a large number of natural artesian springs, and they believe that by artesian irrigation many hundreds of thousands of acres will yet be reclaimed for the use of man.

Australia and Africa

have this striking difference among others. Africa is like an inverted saucer, the interior being higher than the rim of the continent. Australia is the saucer in its usual position, the inner plateaus being lower than the more or less mountainous outer portions. When the early travellers saw the country beyond the highlands of the south-east coast descending to lower levels they imagined there must be some great Caspian Sea within which received all running waters. In place of this central imaginary sea, however, there exist only comparatively small basins without exterior drainage; and it is the utter lack of rivers available as highways to the far interior that has made the exploration of inner Australia so exceedingly difficult.

GLEANINGS OF THE GLOBE.

A SMALL axe of nephrite found at Ohlau, in Silesia, has been identified as to the specific gravity, microscopic structure, and chemical composition of the stone, as the same with a mineral occurring near Jordansmühl, in Silesia. This is the only prehistoric object found in Europe of which the source has been satisfactorily determined.

WHEN an infant has once breathed, the lungs become lighter than water; hence if a dead infant has been born alive and a piece of lung be cut off, it will float in water, but if the child be born dead the lung will sink. The lungs are the only viscera that will float in water, hence the popular designation of "lights" is applied to them.

AT the month of Nehalem river, on the coast of Oregon, is washed ashore at high tide, a substance having the appearance of a mineral and the qualities of fine bees' wax. It is also found on shore in black soil where trees are growing, at considerable elevations above the water. It is sold in Astoria at the regular price of bees' wax. It belongs to the hydrocarbon series, allied to amber, a fossil remain of the resinous trees of the tertiary age.

A BAT cannot rise from a perfectly level surface. Although it is remarkably nimble in its flight when once on the wing and can fly for many hours at a time without taking the least rest, if placed on the floor or on flat ground it is absolutely unable to use its wings. The only thing it can do is to shuffle helplessly and painfully along until it reaches some trifling elevation, from which it can throw itself into the air, when at once it is off like a flash.

A CORRESPONDENT points out that if space be supposed curved, as was described in the reply to query number 139, then for the reflection of energy at the limits of the universe, discussed in our article on "Creation and Chaos" (p. 327) we should substitute the idea of closed lines in which radiated energy travels continuously, to return to its starting point after a period which, if it could be deduced from astronomical considerations, might furnish a measure of the extent and curvature (supposed uniform) of space.

A USEFUL preparation for the bath has been introduced by Messrs. Hoppell and Co., of 35, Haymarket, S.W. It is a perfumed alkaline powder (Poudre Adoucissante), and has the effect of allaying irritation and promoting a healthy action of the skin. The makers claim also that it is useful in rheumatic and gouty afflictions. Personally, we have found it excellent in softening water, delightful in aroma, and exhilarating to the general system. We consider it of great hygienic value.

AT last that most indispensable of all boons, the sewing machine, has been placed within the easy reach of all. The new machine has been christened the "So All," and well it justifies its name. From a personal inspection we can not only assert that it is an excellent worker, but that it is a perfectly and strongly constructed machine in every respect. It works by treadle or by hand. The hand machine is sold as low as 27s. and the treadle machine at 47s. We are approaching the third jubilee of the Weisenthal's invention of sewing by machinery, and the invention of the "So All" comes, therefore, at a fit moment to crown the occasion.

ABOUT half a pint of water is thrown off by the lungs every half hour.

AN extensive human settlement, belonging to the stone age, has been discovered near Schaffhausen, Switzerland, by Dr. Ruesch, and is being laid bare under his supervision. It is in a rocky niche, about thirteen metres high and thirty-seven metres long, and is the first of that period that has been discovered in Switzerland which is not connected with a cavern. The overhanging rocks offered a roof as protection against the weather. Quantities of flint knives, chisels, and lance-heads, bones of the reindeer, roe, stag, hare, cave-bear, and other animals, and human bones, needles, and the beginnings of drawings, were also found here.

FEW people have an idea how thin a sheet of veneer may be cut with the aid of improved machinery. There is a firm in Paris which makes a business of cutting veneers, and to such perfection have they brought it that from a single tusk 30 inches long they will cut a sheet of ivory 150 inches long and 20 inches wide. Some of the sheets of rosewood and mahogany are only about a fiftieth of an inch in thickness. Of course, they cannot cut all woods so thin as this, for the grain of many varieties is not sufficiently close to enable such fine work to be done, but the sheets of boxwood, maple, and other woods of this character are often so thin as to be translucent.

A SUGGESTION was made in *Ciel et Terre*, some time ago, that the date be regularly noted, as a climatological fact, of the day, for each place on which certain agricultural operations particularly in harvesting are begun. As the ripening of the crops depends on the absolute amount of heat they have received during the season, the date of beginning the harvest will determine when the amount of heat required by each plant has been accumulated. Father Cl. Buvé, curé of Linsmeau, Belgium, suggests that the measurement of the amount of beet-sugar produced from a given quantity of beets will serve the same end; for, other things being equal, it is entirely dependent on meteorological conditions.

The prospectus is just issued of the Palace Theatre, Limited, formed for the purpose of purchasing the freehold theatre hitherto known as the Royal English Opera House, and of converting that house into a high-class music hall of the Empire type. As is well known, the Royal English Opera House is one of the finest buildings of the kind in Europe. It stands upon 13,256 square feet of land, and is an absolutely fire-proof structure. In arranging for this transformation, the promoters have availed themselves of the invaluable services of Sir Augustus Harris, who, from his association with the Empire and other highly prosperous undertakings of a like nature, is probably the best qualified man in Europe to assume the control of such an enterprise. Bearing in mind the fact that the Empire has paid its shareholders ever since its inauguration as a variety theatre, in 1887, dividends of not less than 70 per cent. per annum, that the Alhambra has paid from 20 to 40 per cent., and that the Pavilion has paid from 10 to 16 per cent., there is every probability that the new undertaking will enjoy as great a success as its rivals, and that too without doing any injury to them.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 40.

163.—Why does an intaglio (depressed) image become, apparently, a cameo (relief) image, and vice versa, when viewed by candle light through a convex lens?

The best method of observing this deception (although a simple convex lens is sufficient for it) is to view the engraved seal of a watch with the eyepiece of an achromatic telescope, or with a compound microscope which inverts the objects that are viewed through it. The experiment should be carried out in a room entirely darkened, except for the light of a candle by which the seal is illuminated *from one side*. The cause of the phenomenon is that with the reversal of the image, of course the *shading* is also reversed, and the observer being conscious that the lighting is still from the same side of the seal, naturally concludes that the transposition of the shades is due to an (apparent) reversal of the "hills and hollows" of the image.

164.—Do ventriloquists speak from the throat, or, as is sometimes stated, from the stomach?

Ventriloquism loses its distinctive character if its imitations are not performed by a voice from the belly. The voice, indeed, does not actually come from that region, but when the ventriloquist utters sounds from the larynx without moving the muscles of his face, he gives them strength by a powerful action of the abdominal muscles. Hence he speaks by means of his belly, although the throat is the source from whence the sounds proceed. The whole art is based upon the fact that the ventriloquist is, to all *appearance*, mute, and upon the uncertainty that exists with respect to the true direction of sounds in general.

165.—How is electricity measured, and what is the unit of this force practically employed in connection with electric lighting?

The measurement is usually effected by means of an instrument, called a galvanometer, in which a small permanent magnet (a steel compass needle), pivotted as in a magnetic compass, is placed just over or underneath a horizontal wire, through which the current to be measured can be passed. If it is desired to make the instrument more sensitive, the wire may be several times wrapped round the pivotted magnet, so as to form an oblong coil. If the galvanometer is so placed that the magnet when at rest lies parallel with the wire or coil of wire in its proximity, then the passage of a current will cause the magnet or compass needle to set itself more or less at an angle with the coil. An index fixed to the pivotted magnet indicates upon a graduated scale the amount of current passing in "amperes." This is the measure of what is commonly called "quantity" of current. To find the *force* of the current a length of very fine wire, offering an extremely high resistance to the passage of electricity, is placed in the circuit. The deflections of the galvanometer, indicating the amount of current passing, will then be proportional to the electric, or, as it is more properly named, the electro-motive force available for overcoming resistance. The units of this force are called volts. The practical, or Board of Trade, unit employed in electric lighting, is any current of electricity in which the amperes multiplied by the volts are equal to 1,000. Thus it may be a current of 20 amperes, having an electro-motive force of 50 volts, or it may be one of 500 amperes, whose E.M.F. is only 2 volts, and lasting for one hour.

166.—What is the explanation of the spectral forms that sometimes seem to dance before the eyes in illness?

In a state of indisposition the phosphorescence of the retina frequently appears in new and alarming forms. Pressure of the blood-vessels upon the optic nerve or upon the retina may show itself, in total darkness, by a faint blue light floating before the eye, varying in its shape, and passing away at one side. This blue light may increase in intensity, passing into green, yellow, and sometimes red, or all these colours may be seen simultaneously. Considering the variety of distinct forms which, in a state of perfect health, the imagination can conjure up when looking into a burning fire, or upon an irregularly shaded surface, it is easy to conceive how the masses of coloured light which float before the eye, under the conditions just mentioned, may be moulded by the same power into those either fantastic or natural shapes which so often haunt the couch of the invalid.

167.—Why is the summer so much hotter in the Southern than in the Northern Hemisphere?

Owing to the earth's axis being inclined to the plane in which its orbit lies, the Northern Hemisphere is nearest to the sun during one half-year, and the Southern Hemisphere is nearest during the other half-year. But the orbit of the earth is an ellipse, and during the half year in which we have our summer, in which, that is to say, the Northern Hemisphere is inclined to the sun, we are slightly more distant from that luminary than during the period of the southern summer. It is, therefore, in the Southern Hemisphere that the greatest intensity of solar heat is felt.

168.—When is our neighbour, the planet Mars, to be seen to the best advantage?

Mars is, of course, nearest to us when it, the earth, and the sun, are in one line. Also, when this is the case, Mars is in the position, directly overhead at midnight, that is most favourable for telescopic observation. But there is another important difference between the "oppositions" of Mars that is due to the great eccentricity of its orbit. Mars moves, indeed, in a much more eccentric orbit than any of the other large planets, excepting Mercury, and hence the most favourable opposition occurs when Mars falls in line with the earth at that point where the line joining our orbit with his is the shortest; that is, at a date as near as may be to August 26th. Such a "favourable opposition" takes place this year. The next will happen in the year 1909. [See "Mars' Moons" in last issue.—Ed.]

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

175.—What is the cause of the change of taste and colour in food after cooking; and why is cooked food more wholesome?

176.—Why can some fish live in salt water, but not in fresh, and *vice versa*?

177.—What is the source and process of manufacture of iron ?
178.—How is unbreakable glass made ?
179.—What is the difference between a quicksand and ordinary sand, and are there any unfathomable quicksands ?
180.—What is the scientific explanation of the changed condition of water when it is boiling ?

LEFT-TO-RIGHT WRITING.

The most of the writing in the world is now done from left to right, but the time was when the majority wrote, and consequently read, from right to left. How came the change to be made ? Mr. Grant Allen has a theory on the subject which is worth looking at. He says that originally the written characters were carved, scratched, or incised, and the right hand was allowed to follow its natural course from right to left. This tendency may be seen at the present day, for every stonemason chips his material from right to left. The practice was continued when waxen tablets were used for writing upon with a stylus, before pens and ink were invented.

When the Greeks began to use pigments instead of the stylus, they found it easier to write from left to right ; but the new system had to make its way gradually. About 600 years B.C. they wrote as all the rest of the world did, from right to left. They then began to write zigzag fashion, making one line from right to left and the next from left to right. After thus trying both ways, it was not long before they saw that the course from left to right was the most agreeable, and they adopted it as their only method. That they were right, nearly all the world now bears testimony. There is no need to search for any other explanation.

The Greeks were the first innovators because they were not hampered with traditional prejudice, as were the Egyptians, Hebrews, and Phœnicians. They studied convenience and common sense, and they did not go wrong. It is an obvious advantage to us to see what has been written, so as to know what to write next. The new method was favourable to rapidity, and they wished to do something more than copy old records. The Greeks found the left-to right writing the most pleasant, convenient, and physiologically natural. If they had not done so they would not have changed their old habits. It is not to be supposed that they reasoned very deeply on the subject. They liked the new system, and that was sufficient. Mr. Grant Allen's theory is sound, in so far as it accounts for the origin of the right-to-left system, although it is hardly sufficient to account for the change introduced by the Greeks. All that we have to do is to be thankful to the Greeks for their good sense in studying their own ease and comfort.

VOLUME I. OF "SCIENCE SIFTINGS"
IS NOW READY.
Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.
Or from Messrs. W. H. Smith & Son,
and through any Newsagent.

AN INDEX TO VOLUME I.
may be obtained on application to the Publishers, price 2d., post free 2½d.
Covers for binding Vol. I, price 1s., post free, 1s. 2d.

If you have an idea for a patent, write to the Editor of SCIENCE SIFTINGS, giving the outline of your scheme. The communications will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

ELECTRIC-BELT QUACKS EXPOSED.

Practitioners of a shady character do well to avoid the search light of expert criticism encountered in a court of law. But, fortunately for the public, blunders are committed now and then, even by the shrewdest of the quack fraternity. A case in point has just occurred, and this is what our contemporary, *The Electrician*—undoubtedly the leading authority on electrical science—has to say about it :

> THE MEDICAL BATTERY COMPANY (under which title the Harness "electropathic" belts are made) has attempted to recover five guineas from an unfortunate man who submitted himself to them for treatment. Medical evidence showed that he was suffering from hernia ; but a furniture salesman employed by the Battery Company to look after such patients did not recognise it, and "fitted" him with a belt which chafed the skin and caused excruciating pain . . . In the result, the Company's application was dismissed, and the counter-claim for return of part payment was allowed with costs. It is a pity the case did not turn upon the "electrical properties" of this so-called "electric" belt. We yet hope to learn that the subject of these wretched impostures may lead to a successfu Treasury prosecution.

There seems to be no reason to suppose that, in this particular case, the Harness Medical Battery Company was either more or less successful than usual in effecting the cure of the patient. The only peculiarities of the case relate to the impudence with which the plaintiffs, the Harness people, pressed their "contract," in the face of the publicity necessarily given to their methods in a properly defended action at law. We say publicity. But for what reason is it that no reports of this important action have appeared in the daily press ? There is only one answer to the question. It is because the "Medical Battery Company" is an extensive advertiser. We greatly regret the tacit understanding—amounting virtually to a compact—that exists between so many newspapers and the various advertising charlatans, as to the repression, for business purposes, that is to say *for mutual benefit*, of everything that tends to injure the business done by those impostors.

We believe it to be part of our duty to the public to show what grounds we have for characterising some of the business of the Harness Medical Battery Company as of a shady or very questionable character. To this end we will give a few extracts from the report of the evidence.

Mr. Lickfold, addressing the Court for the defendant, stated that he (the defendant) having, as he feared, ruptured himself, his attention was attracted to an advertisement calling attention to the Electropathic and Zander Institute, 52, Oxford-street, where medical advice was given gratis. He asked to see a medical man. He saw a Mr. Simmonds, and told him he was suffering from rupture. Mr. Simmonds examined him, and told him he was not so suffering, and added, "You must have one of our belts, that will set you right." The defendant was fitted, and took a belt costing £5 5s. Instead of doing good, the belt chafed the skin and caused an eruption, and the illness was so aggravated that the defendant consulted a medical man, Dr. Rowntree. After going through the facts, Mr. Lickfold said he should produce evidence to prove that these so-called electric belts were nothing else than fraudulent impositions. People were inveigled into this trap, and belts, which were absolutely worthless, were palmed off on them, and they were ashamed to proclaim their folly by prosecuting the promoters of these impostures. But it was now time that it should be put a stop to. The learned gentleman submitted that there had been misrepresentation in this case, because Mr. Simmonds was not a qualified man, and because he misled the defendant by telling him he was not

suffering from hernia when he was so suffering. Then the defendant was entitled to have his money and I.O.U. returned to him, as he had not received any good and proper consideration for his money.

The defendant, Mr. D. Jeffery, said he was very pleased at being told he was not ruptured. He wore the belt for some time, and it gave him great pain. There was a downward pressure, and a lump formed in his groin—an external sore also formed. When he took off the belt he felt relief. He consulted Dr. Rowntree. He left off the belt entirely, and wore a truss, which cost 12s. 6d. He was much better now. The doctor told him he was ruptured, and had been so for some time.

In cross-examination by counsel for the plaintiff Company, the witness stated that he wore the belt for more than a week. He did not ask the price of the belt before it was fitted on, and had he known it was £5 5s. he would not have purchased it.

We now come to the evidence upon which Mr. Lickfold relied to prove that these so-called electric belts are nothing more than fraudulent impositions. Mr. W. S. Rowntree, L.R.C.P., called for the defence, stated that on May 23rd, Mr. Jeffery called on him at his house. He examined him, and found that he was suffering from rupture. There was no doubt about the nature of his suffering. He had examined the belt, and he was of opinion that if it was fitted tight on a patient suffering from rupture it would aggravate the complaint. He had heard the defendant's evidence as to the swelling in the groin, and he thought that that swelling had existed for some time previous to witness seeing him. The belt *would not be of any use* to the defendant. He recommended a truss, and the patient was getting better.

Mr. T. E. Gatehouse, an electrical engineer, was also called. He said that the belt in question had no electrical powers, and was utterly useless. As the belt was worn it never produced a trace of electricity. That morning he had made an experiment with the belt, so as to produce a small quantity of electricity. He took salt water, and moistened the two parts, and then he connected the copper and zinc with a galvanometer, and so he got a slight deflection of the needle of about 14 degrees. He then put the belt on his legs and on his arms, and the deflection was not in the slightest degree altered. That showed that when these belts were worn by any patient, no electricity passed through the body in any way whatever, but only along the webbing of the belt and over the skin surface. Electrically these things were useless.

Cross-examined by counsel for the Harness Company, this witness added that although zinc and copper were used in generating electricity, the belt would produce no current at all as the defendant wore it. The circuit was not completed. He saturated the belt with salt water, and then he got a smal electrical current. He said there was a current if properly connected up, but the current would not go through the body—it was the webbing and skin and not the body which formed the internal circuit.

The last statement is, we take it, meant to be interpreted somewhat broadly. The meaning of it is that when two paths are open to a current of electricity, one conductive (that is to say offering but little resistance to the passage of the current) and the other practically nonconductive (offering that is to say, a very great resistance) the current divides itself between the two paths in proportion to their conductivities. Now Mr. Gatehouse succeeded in measuring a very small current of electricity, generated by the belt, and traversing the moist webbing of the belt and the skin, that is to say, *a conductive circuit*. But his experiment proved that to such a weak current as this the human body, internally, is practically a nonconductor. For when Mr. Gatehouse offered to the current generated by the belt the *additional path* through his leg or arm it (the amount of current flowing) was found to be not appreciably greater than before.

The additional current, if any, was too small to be measured on Mr. Gatehouse's sensitive galvanometer. We should suppose, as a matter of fact, that an infinitesimally greater current must have passed in this last experiment—that an infinitesimal current must have actually passed through Mr. Gatehouse's leg or arm. But the point proved is that while the passage of a slight superficial current might be just sufficient to cause annoyance by "chafing the skin," the effect, beneficial or otherwise, of the "electric current" from such a belt upon any internal organs must be *absolutely inappreciable*.

Now, let us see what the plaintiffs, through Mr. F. T. Simmonds, had to say in support of their contention. "That though there might have been an error in judgment on the part of Mr. Simmonds, there had been no wilful misrepresentation—such as according to legal ruling would entitle the defendant to have his contract rescinded and his money returned."

Mr. Simmonds observed in reply to his own counsel that he had recommended the electric belt "in order to decrease the pressure, and to give a tonic to the muscles."

Mr. Lickfold extracted from him the fact that he had been employed by the plaintiff company for nearly seven years. He began treating hernia after he had been with them for about three months. Before being employed at Harness's he was engaged in commercial pursuits. He had studied hernia all his life; ever since he was nine years of age! His "commercial pursuit" before he was employed by the plaintiffs was that of salesman in Oriental furniture in the West End of London. He did not acquire (? require) much knowledge of the treatment of hernia in selling Oriental furniture. But after being in the plaintiff's employ for three months developed into a consulting person. He had assistance from others. He was now one of the consulting officers. He did not send for one of the medical attendants because in matters relating to hernia his practice was far beyond theirs. (The Powers preserve us from the attentions of the other medical attendants. —Ed. *S.S.*) He did not think it necessary to consult them except in very complicated and abstruse cases—and then they generally left it to him. The belt sold to anp worn by the defendant weighed between 2 lb. and 3 lb. It was a proper belt for incipient hernia. There was electricity in it. The patient did not require more electricity than he would get out of the belt. Witness on being asked to pledge his oath that there was any electrical current in the belt, said he had no knowledge of electricity.

Of course, judgment was given for the defendant, his money to be returned to him. His Honour, in passing judgment observed that a representation had been made by a man who had not taken the trouble to qualify himself, and who ought not to have made any representation at all. That was the representation which led to the contract, a contract without any good of any sort to the defendant, and it must be voided. It is a pity, as is observed by the *Electrician*, that the case did not turn more directly upon the "electrical" properties of these belts, which, according to the vendors, "cure" almost every ill that flesh is heir to. We trust, however, that this exposure will tend in the future to restrict the foisting of worthless "electric" belts upon the too-credulous public.

FOSSILS.

In nearly every part of the earth, and in the strata of every geological period, we find the remains of organisms which lived out their lives ages ago, and, owing to the circumstances of their death, have been preserved for our enlightenment in these latter days. They include all classes of organised life, both vegetable and animal, and from a careful study of their characteristics we are enabled to learn much of the condition of the earth in those far off times.

The word *fossil* is derived from the Latin, and means, primarily, "something dug up"; and this is a fairly accurate definition, as fossils vary so much in character, form, and condition that it is difficult to give a strict definition of the term. The flint arrow-heads of prehistoric man, or the foot-prints of the Mesozoic birds preserved in hardened mud, are as truly fossils as the trilobites of the ancient Silurian strata, or the petrified fishes of later periods.

Although fossils are comparatively abundant, they probably represent but a small fraction of the forms of life which have existed upon the earth. Only when they died under exceptionally favourable conditions for preservation would there be any trace of their existence left. Take the present time as an illustration, and how few remains of animal life are to be found. How rarely do we discover a dead bird or other wild animal, and yet they live and die by millions. When Massachusetts was first settled, for instance, deer were very abundant in its forests, but we have yet to hear of the discovery of a single bone or other trace of this almost extinct animal in this state. If, in the course of ages, the present surface of the earth should be covered over with other strata, the geologist of the future will have no means of knowing, from any fossils that he can discover, anything about the fauna of our era, and all that would be preserved would be a few beds of salt or fresh-water shells, with perhaps an occasional bone of a fish or some larger animal.

It is evident that animals or plants living in or near bodies of water are in the best position for preservation; and we find that the most abundant fossils are those of molluscs, fishes, and other marine animals; while the abundant vegetation of the carboniferous period, growing in immense swamps, was quickly buried up in the mud and water, and thus converted into the coal-beds of the present day. Remains of land animals are rare, and those that have been found owe their preservation to the fact that soon after their death they were buried up by water and the sediment deposited therefrom, and their bodies thus preserved from complete decay. The body of an animal dying on dry ground and exposed to the destructive action of the elements, would entirely disappear in a very short time; and there have undoubtedly been thousands, and even millions, of forms of life existing upon the earth in past ages of which we have not the slightest knowledge.

The earliest fossil yet discovered—if it is a fossil at all—is the *Eozoon Canadense*, discovered in the Archæan rocks of Canada. This appears to have been a marine animal of an extremely low type. The rocks in which it occurs, however, have been so altered by the action of geological forces that it is extremely difficult to determine the exact nature of the alleged *Eozoon*; and many distinguished geologists believe that it is not a fossil at all, but merely a deposit of carbonate of lime which has filled certain cavities in the original rock in such a manner as to resemble the form of an animal.

Organic remains may be preserved, or fossilised, in many different ways. The calcareous skeleton of the *Eozoon* above referred to has been so altered by pressure and heat that considerable doubt exists as to whether it is a fossilised animal or a mineral deposit. Shells of marine or fresh-water animals may be covered up by sediments of sand or clay and preserved indefinitely with little alteration in their form or composition. The bony framework of the higher animals may remain inclosed in the rocks formed by the hardened sediments, while the soft, fleshy parts would soon decay and disappear. Or, on the contrary, the entire body of the animal may become infiltrated with solutions of lime or silica, and, by a process of substitution, the particles of soft flesh may be replaced by indestructible limestone or quartz, while perfectly retaining their original shape. These last constitute the true petrifactions. The tracks of birds and animals, or the prints of rain-drops and wave-marks on a sandy or muddy beach, may become covered up by subsequent deposits and hardened and consolidated into rock.

The coal-beds are principally composed of vegetable fossils, the remains of the luxuriant vegetation of ancient swamps which were covered up by sediment deposited from the water, and underwent a process of partial decomposition by which the vegetable matter was transformed into coal. A similar process, on a small scale, is going on in every peat-bog at the present day.

As we approach more recent times, the character of the fossils changes, and we find less alteration of the original form. The remains of the Siberian mammoth, which had been frozen up in the mud in which it perished for many thousands of years, is a well-known instance. Although this animal had probably been dead for thousands of years, it had been so perfectly preserved by the cold that its flesh was eaten by the dogs which followed the discoverers. We find in recent strata the flint and stone implements of the earliest men, and in a few instances portions of their skeletons. In historic times the skeletons of some Caribbean Indians were found in a coarse conglomerate, together with modern coins. Although the date when these individuals perished was well known, yet they were perfectly fossilised, and might have remained for ages in the situation where they were found. In the Luray cavern there is the skeleton of an Indian boy, partially imbedded in the stalagmite, and forming an instructive object lesson of the way in which fossils are formed. Coming down to the modern period, we may mention the Egyptian mummies and the relics of the Greek and Roman nations as the latest remains to which the term of fossil could properly be applied.

The presence of fossils in any geological stratum is the best, and sometimes the only, means of determining its age or the period to which it belongs. During the lapse of ages the forms of life were constantly changing, and at certain periods there were certain forms characteristic of the time. The division of the rocks into geological ages and periods is misleading, in that it gives an impression of a distinct separation between them. There was no sudden change from the Silurian to the Devonian period, for instance, but a gradual and comparatively uniform progression from one period to the other; as the land and water changes places, mountain chains were raised up and worn away, and the ever-changing forms of vegetable and animal life appeared and became extinct. The Devonian Age has been called the age of fishes; it does not signify that there were no fishes previously, but that in the Devonian Age fish-like forms of life were more abundant than previously. It was simply the culminating point of the race of fishes.

The stream of life on our globe has flowed for millions of years, and from the few remains which it has cast up for our inspection we have been enabled to form a fairly satisfactory history of the earth; but we do not know, and never

shall know, how much still remains concealed from us, or the actual conditions prevailing in those ages whose length can only be estimated in millions of years.

A FOOD FALLACY EXPLODED.

In our issue of April 30th we published a very simple little experiment that thoroughly exploded the notion entertained by the majority of people that there is any nourishment in beef tea. We are glad to find that our brief remark has gi en an impetus to thought, and that the matter has been taken up and elaborated in *Wheeling* by no less an authority on dietetics than Dr. George Herschell, of 5, West-street, Finsbury-circus. The trend of his remarks specially applies to athletes. He mentions that from a long consideration of the methods of feeding cyclists whilst upon the course, he has come to the conclusion that they do not succeed in utilising all the energy of which their bodies are capable.

He even goes so far as to say that it is his deliberate conviction that under better and more scientific conditions all the existing long-distance records might be broken. He demonstrates that by the method of feeding at present adopted the racer is not only starved, but also in many cases his muscles are absolutely poisoned by the substances given him as food, and that thereby he is rendered incapable of exerting the same energy as he might under better conditions—that is to say, if he had nourishment which was capable of replacing the wear of the system administered to him continuously in small doses.

To come from the general to the particular, Dr. Herschell points out two facts which are now thoroughly established beyond dispute, and deduces from them the lessons which they teach. He also suggests a more rational and scientific method of feeding.

Firstly.—It has been proved that during actual exercise no gastric juice is secreted, and, consequently, digestion in the stomach is at a standstill.

This was established by the experiments of Dr. Cohn, reported in the *L'Abeille Medicale*, November 19th, 1888. A meal of scraped meat and water was given to a number of dogs, which were then divided into two batches. The one set was allowed to rest, whilst the other was taken out and actively exercised for two hours. At the termination of this time a small quantity of the contents of their stomachs was pumped up and submitted to a careful chemical examination. The results were most striking and conclusive. In the stomachs of the dogs which had rested digestion was at its highest point. In the others it had not commenced. It was only after three hours' rest that digestion began again, and after six hours it was not finished.

These observations prove conclusively that no ordinary food taken during a race will supply a particle of energy to the system, because it is not utilised. It simply remains a dead weight upon the stomach. Yet the rider craves for food, exhausted nature crying out for support, and he probably fancies that it is doing him good because, by its presence, it mechanically deadens the craving to some extent. And yet, apart from the water which he is taking, he might just as well, for all the good it does him, let nothing pass his lips until the race is finished.

Secondly.—There is no nourishment in beef tea.

There is a widespread delusion, as we have already mentioned, on the part of the public as to the food value of this preparation. It is commonly supposed that a large proportion of the nourishing part of the meat is extracted, and that the remainder from which the beef tea has been made is of no food value. This is entirely erroneous, as the proteid, or nourishing part, of meat is quite insoluble in boiling water, or, in fact, in water above 160° F. Beef tea, as ordinarily made, consists of nothing more than the flavouring agents (extractive) and salts of the meat, together with a certain quantity of gelatine. The strong beef tea, made in a covered jar in the oven, which the British housewife prides herself upon, which sets into a thick jelly on cooling, owes this latter property to the aforesaid gelatine, and to that only. The vices of a beef tea are to be thick, gluey, and strong, as it is not nearly so digestible, the digestion of gelatine being a complicated process. Besides which gelatine, being a proximate organic principle, is incapable alone of sustaining life.

In such beef tea, all the real nutriment of the meat is thrown away in the débris remaining in the jar, after the tea has been strained off. This fact can easily be proved by anyone who will take the trouble to feed two dogs, the one upon the strongest beef tea that can be made, and the other upon the shreds of meat from which it has been extracted. The former will die of starvation before long, the other will live in perfect health and strength. Moreover, in addition to the fact that beef tea is of no food value, it is *absolutely poisonous in large doses to those engaged in active exercise*, as the extractives which it contains in such quantities are analogous in composition and action to the poisons which accumulate in the muscle substance during exercise, and to which the sensation of fatigue is now thought to be largely due. The potash salts, moreover, in beef tea act as direct depressing agents to the heart.

Beef tea will, therefore, certainly increase the sense of fatigue, not remove it. Of course, these remarks do not apply to beef tea made by modern scientific methods with cold water and hydrochloric acid and peptonised.

Let us now direct our critical attention to the actual reported diet of a cyclist upon a long-distance ride.

We have received some interesting details regarding Stephane, the winner of the Paris Bordeaux contest, from F. de Civry, who had control of his arrangements *en route*. The French ex-champion tells us that he never let Stephane stop more than 35 seconds at the checking places—in fact, only the time to sign his name and go. He always had three men with him in the day, and about four in the night. The pacemakers had all that was required on the machine in a bag in front of the head. He had nothing whatever on his machine, which was a full racer, weighing complete only only about 25 lbs. He had no feeding, but drank beef tea all the way, as well as tea and a little coffee, and two or three bottles of French lemonade. De Civry also gave him some extract of Mathé, which is an American drink. He did not have a mouthful of solid stuff, but nearing the close of the long ride he was sustained with champagne with eggs beaten in it.

Here we see that the rider had absolutely no sustaining food during his ride. The eggs he could not digest, and the beef tea, we have seen, was worse than useless. What might he not have accomplished if he had been differently fed!

From a consideration of these points Dr. Herschell is driven to the conclusion that our long races are performed under conditions of practical starvation as far as any good the food taken does the riders. The question, therefore, naturally arises in our mind whether, seeing that such wonderful records are made under such very unfavourable conditions, much better ones could not be obtained, provided that a nutriment could be administered which could really be absorbed and thus impart real strength and force to the rider. Dr. Herschell personally believes they would. It

remains, however, for experience to demonstrate the truth of his theory or to show its fallacy.

We have such foods already in use by medical men in certain diseased conditions, such as infectious fevers, where the patient is practically in very much the same condition as regards his food as a cyclist doing a long ride. The function of digestion is more or less in abeyance. Such patients we feed with what are known as *peptonised* or *predigested* foods. These, when taken into the stomach, require no further action upon them of the digestive fluids, but are absorbed at once into the system. Pepton is the soluble substance formed when meat is acted on by the gastric or pancreatic secretions. Peptonised foods are those in which the albumenoids have been artificially converted into this substance by admixture with preparations of these fluids or their equivalents. The most eligible foods, in Dr. Herschell's opinion, for cyclists will be found in peptonised milk, peptonised gruel, and peptonised soup. These, moreover, have the additional advantage of being in a liquid form. Their preparation is a matter of great simplicity, and can be easily done usually on the first attempt.

The following methods put forward by Dr. Herschell may be relied upon for the preparation of the foods mentioned.

Peptonised Milk.—Dilute a pint of milk with a quarter of a pint of water and heat it to 140 degrees Fahrenheit. Two teaspoonfuls of Benger's liquor pancreaticus or one of Fairchild's peptonising powders (procurable at any chemist's), together with 20 grains of bicarbonate of soda, are added and well mixed up. The mixture is then poured into a covered jug, covered with a tea cosy, and placed in the fender to keep in the heat. At the end of an hour pour into a clean saucepan and raise once to the boil. It may now be used as ordinary milk. If found to be too bitter do not continue the process longer than half an hour.

Peptonised Milk Gruel.—A thick ordinary gruel is prepared and mixed with an equal quantity of cold milk whilst it is still as hot as possible. This will cool it down to 125 degrees F. To each pint add two teaspoonfuls of liquor pancreaticus, and 20 grains of bicarbonate of soda. Set it aside in a warm place for two or three hours, and finally raise to the boiling point and strain.

Peptonised Soup.—This may be made in two ways. The first and easiest is to add a strong stock to an equal quantity of peptonised gruel. The other and better way is to first prepare a thin water or milk peptonised gruel, and use this instead of water in the preparation of soup in the ordinary way from shins of beef, etc. Care must be taken that the gruel is very thin and watery.

THE GREAT AUK'S EGG.

The egg of the great auk is, for two reasons, one of the most precious possessions a collector can acquire. The first is the singular appearance of the egg itself, it being about the size of a swan's, of a yellowish colour, and irregularly marked with black in a style that closely resembles the characters of Chinese writing. The singularity of the egg would thus make it an object of curiosity were it often found, but a great auk's egg is now extremely rare, owing to the disappearance of the bird. It was once very common and found on every island and coast of the arctic seas, but being a true sea bird it was ill adapted to flight, its wings being almost rudimentary, and so the species has practically become extinct from its members being slaughtered by sailors.

ELECTRIC LIGHT IN MEDICINE.

There recently died at Vienna the mechanician Josef Leiter, a man who, in concert with eminent physicians, spent many years of his life in zealous study and experiment in order to realise one of the most modern and remarkable ideas of medical science. He was engaged with the solution of the question how far the interior of the human body can be made accessible to the eye of the physician. Before his death he had the satisfaction of knowing that his merits were fully acknowledged in a recent work by the distinguished neurologist Prof. Lewandowski.

The medical world is already able to illuminate the interior of the mouth, the pharynx, the stomach, eye, and ear, with the electric light. This is effected either by the direct introduction of the source of light into the organs concerned or by the reflection of the light. At first the light of incandesced platinum wire was used, but latterly the well-known carbon filaments of the glow light have been universally employed. The "mignon" glow lamps, scarcely larger than an ordinary pea, were first shown at the Vienna Electrical Exhibition, and were successfully adapted to this use by Leiter. A number of apparatus for both methods of introducing the electric light (direct and by reflection) have been devised. The instruments for the use of reflected light do not differ in principle from those used for solar light. The electric light has, however, the advantage that the medical expert is rendered independent of the freaks of the weather. This principle can, of course, be combined in all possible manners with concentrating lenses, reflectors, etc.

The first such apparatus of this kind emanated from Vienna, where they were executed in 1883 by the Optician Jirascho, at the instigation of Prof. Mosetti von Moorhof. In the direct introduction of light the *Electrical Review* distinguishes two modifications, illumination properly so called and diaphonoscopy. This latter method depends on the fact that human flesh is, in thin layers, translucent. If we hold up the open hand with the fingers close together before a brilliant light (not otherwise visible to the observer), the fingers appear at their margins translucent, and transmit a reddish light. This method is used in dentistry. The patient bites a small gag of vulcanite, the lateral process of which, projecting into the mouth, supports a mignon lamp. The interior of the mouth is brilliantly illuminated, and the dentist can look into the inside of the tooth and detect any morbid changes in the enamel, the dentine, the roots, the gums, etc.

The most interesting method at present is that by which the light is directly introduced into the cavities and passages of the body. In examinations of the pharynx a mignon lamp is placed in the shaft of the mirror and the rays are allowed to fall into the pharynx, which is thus brilliantly illuminated and reflected to the eye of the observer. Much more complicated is the introduction of light into the stomach, which is first evacuated by means of the stomach pump and afterward expanded with air after the apparatus has been introduced. This apparatus is a long tube which has at its closed lower end a glass window, behind which is placed a mignon lamp connected with the battery by wires. When the current is turned on the filament becomes ignited, and illuminates through the window the interior of the body, while a small mirror makes the illuminated parts visible to the observer It will be perceived that the electric light plays already not an unimportant part in the art of healing, although we see only the beginning of its career.

PRESERVATION OF FLOWERS IN THEIR NATURAL FORM AND COLOUR.

A "Constant Reader" asks how flowers can be preserved in their natural form and colour. The following are some of the processes that have been recommended :—

1. Take a wooden box of any convenient length and width, but at least five inches in height, and provide it with a sliding bottom. About a quarter of an inch above the latter fasten to the interior sides of the box a piece of wire gauze having wide meshes.

Now procure some fine white sand, pass it through a hair sieve and wash it thoroughly in water, in order to remove every particle of foreign matter. Place the washed sand in an iron pot and raise it to a temperature of about 200° in a stove or oven. Add to the sand, white hot, a melted mixture of stearic acid and spermaceti in the proportions of six grains of each to one pound of sand. Stir thoroughly, and when the sand is cool enough rub it between the hands, in order that every grain may be coated with the fatty matter.

Place a layer of the prepared sand in the bottom of the box and carefully arrange thereon the plant to be dried. Then, with great care, cover the plant with a thin layer of sand, and, having placed a sheet of paper on the top of the box, place the latter in a stove or oven heated to the temperature of about 120°. The desiccation takes place very rapidly. When it is supposed that it is finished, remove the bottom of the box, when the sand will pass through the wire gauze, and the plant will remain upon the latter. Brush the plant with a badger hair brush and preserve it as will be directed below. The prepared sand adheres but slightly to the plants and is always easily removed. It suffices in most cases to give the stem a few fillips to get rid of all of the sand, provided the plants have not been moist.

It must be added that sand, prepared or otherwise, cannot be used for preserving plants that have a clammy or viscous coating. In this case, it is absolutely necessary to use grains of millet or rice.

As the dried plant, when left in contact with the air, absorbs a little moisture, and fades, it must be arranged in a jar or wide-mouthed bottle on the bottom of which has been placed a piece of quicklime wrapped in tissue paper and covered with moss. The jar must be sealed hermetically with a cement of gum lac or rubber.

2. Another method consists in embedding the plants in a mixture of equal quantities of plaster of paris and lime, and gradually heating them up to a temperature of 100°.

On removing a flower from the absorbent it presents a very dusty appearance, and is also somewhat brittle if it has been left in the plaster too long. It is best to lay the plant aside for an hour, during which time it will absorb sufficient moisture to prevent it from breaking when subjected to the necessary dusting to rid it of the superfluous plaster. After being dusted, the plants still have something of a hoary appearance, and, for this reason, they should be coated with a varnish made as follows :

Powdered gum dammar	5 oz.
Turpentine	16 ,,

Dissolve the gum in the turpentine and add 16 ounces of benzoline. Strain through fine muslin.

3. The *Revue de Chimie Industrielle* recommends the following varnish for the preservation of flowers :—

Ether	500 parts.
Transparent copal	20 ,,
Sand	20 ,,

The flowers are to be immersed in this varnish for a couple of minutes, then allowed to dry for ten minutes, and be submitted to this treatment five or six times.

MARVELLOUS MERCURY.

The striking and unique properties of mercury have caused it to be an object of interest and investigation since the earliest times. Being the only metal that is liquid at ordinary temperatures, it has many valuable applications in the arts ; while its property of uniting with metals to form amalgams, and of not adhering to or wetting most other solids, renders it still more useful in many ways.

Mercury is a silver-white liquid metal of high specific gravity (13·54), freezing at a temperature of about 40° below zero—the only point where the Fahrenheit and Centigrade thermometer scales coincide. Its boiling point is correspondingly high, being 662° F.—a temperature readily produced in the laboratory, so that it can be distilled like water. The alchemists, in their vain search for the "philosopher's stone," held this metal in almost superstitious reverence, and distilled and re-distilled it, hoping to be able to transmute it to gold or silver. A few grains of the precious metals, present as an impurity, were all that rewarded their efforts ; but even these were sufficient to encourage them to further exertions, which, as must have been the case, resulted in nothing but a quantity of very pure mercury.

The most common ore of mercury is cinnabar or the sulphide of the metal, which is mined principally in Austria, Spain, and California. The metal is separated from the ore by a simple process of roasting, by which the sulphur is driven off and burnt, while the mercury is set free in the state of vapour and condensed and collected in convenient receptacles.

When mercury is heated to the boiling point for some time in the air, it absorbs oxygen and becomes converted into mercuric oxide (HgO), a reddish powder. If this oxide is heated to a still higher temperature, it is again decomposed, oxygen gas is driven off, and metallic mercury remains behind. This reaction is historically interesting as being the method by which oxygen was first prepared by the English chemist Priestley, and also by the French chemist Lavoisier, who first discovered the true nature of combustion, and recognised the pre-eminent importance of this element in the establishment of a rational theory of chemical philosophy.

Pure mercury will not adhere to glass, and this property renders it particularly useful in the manufacture of scientific instruments. Its regular expansion by heat is made use of in constructing thermometers; while its high specific gravity, which enables a column of mercury about 30 inches in height to balance a column of air of equal sectional area, renders it especially well adapted for barometers.

One of the principal uses of mercury is in the silvering of glass for mirrors. While, as above stated, pure mercury will not adhere to glass, it has the property of uniting with or dissolving other metals, forming compounds known as *amalgams*, which adhere very strongly to clean polished glass. In the manufacture of mirrors, an amalgam of mercury and tin is used. A sheet of tinfoil of the size of the glass is laid upon a perfectly level table, and rubbed over with mercury, a thin layer of which is afterwards poured upon it. The glass, previously cleaned, is then carefully slid on to the table, so that its edge may carry before it the superfluous mercury and the impurities upon its surface. Heavy weights are then placed upon the glass to squeeze out the excess of mercury, and, after several days, the amalgam is found to have adhered firmly to it. The process is one requiring much skill, and the workmen are liable to suffer much from the poisonous action of the mercury vapour.

The amalgams referred to above are of great theoretical interest. The attraction of mercury for gold and silver is particularly strong, and a piece of gold dropped into a dish of mercury disappears like a lump of sugar in water. This attraction for the precious metals is taken advantage of in the extraction of gold and silver from their ores. Iron and platinum are the only metals which are not corroded by mercury, and it adheres even to the latter metal.

When mercury is triturated in a mortar with fine powders, such as chalk, which have no chemical action upon it, it loses its fluid character, and forms a greyish or bluish powder, from which the common medicine known as blue pill is prepared. Although its metallic character is apparently unchanged, there is probably a partial oxidation to which the change is due.

The use of mercury in medicine originated with the alchemists, who sought in it the elixir of life, as well as the philosopher's stone. The metal and its salts have a most powerful effect upon the human system, and, except in small doses, are extremely poisonous. In the treatment of certain diseases, mercury and its compounds are still found indispensable; but the promiscuous drugging with calomel, blue pill, and corrosive sublimate by former generations of physicians is now, happily, done away with. It is a curious fact that while *mercuric* chloride, or corrosive sublimate ($HgCl_2$), is a most powerful poison, *mercurous* chloride, or calomel (Hg_2Cl_2), is much less violent in its action, and is administered in comparatively large doses as a medicine. It is hard to see any reason on theoretical grounds why such a trifling difference in composition should confer such different properties.

Vermillion is a brilliant red pigment identical in composition with the ore of mercury known as cinnabar. Its brilliancy of colour, however, depends upon the process of manufacture, and the Chinese still succeed in making the finest quality by their apparently rude methods.

Chemically, mercury is allied to copper, a metal from which it differs widely in its physical characteristics. From the specific gravity of its vapour, and other considerations, we learn that its molecule consists of a single atom, and we assume that many other metals are similarly constituted, although, owing to the high boiling point of most of them, we cannot make a direct determination.

The metal most resembling mercury in point of fusibility is the rare element gallium, which melts at 86° F., or less than the heat of the hand. When once melted, it remains fluid, even if cooled far below this temperature; but if touched with a piece of the solid metal, it solidifies at once. In all other respects, however, the two metals are very different.

Among the minor uses of mercury we may mention the mercuric fulminate used in percussion caps, the amalgams used by dentists in filling teeth, and its occasional use in gilding and silvering. A few cases have been reported by physicians where several pounds of mercury were given to patients suffering from obstruction of the intestines, with the intention of forcing out the obstructing matter by the weight of the metal. Fortunately, this heroic method of treatment is "more honoured in the breach than in the observance."

While not an indispensable metal, mercury is a very convenient and useful one. It is certainly very singular that only one out of the numerous metals known to us should be liquid at ordinary temperatures; but, perhaps, when the true nature of what we call the elementary bodies, and their connection with each other, are better understood, we may be able to discover a rational explanation for the remarkable differences in their chemical and physical properties.

SOCIAL SCIENCE.

HOW COOKERY CIVILISES.

What did human beings eat in former times? The fact that our teeth are crumbling is laid to our increased use of soft foods. True, it is a fundamental fact that the teeth formerly were used more vigorously, and on more solid foods than at present. But we have not here cause and effect. The teeth and jaws were not strong, because the food was solid; but the food was solid, because the teeth and jaws were powerful. In short, we absolutely repudiate the theory that has been advanced by medical men of late to account for the falling off in our dentition. This is the direct consequence of the improved opportunities of survival by the ill-equipped, due to the knowledge possessed by civilised man of the methods whereby food may be masticated by mechanical means.

In the case of primeval man, natural selection resulted in the extinction of the weak-jawed and toothless. They were ill-fitted to survive, since they could not use the mouth to put the nourishment they consumed into a fit state for assimilation. Therefore, however abundant food may have been with them, they were literally starved to death, while, of course, those better equipped survived by reason of their special fitness. This variation of power created the machine-maker. The first stone-mill was rudely-fashioned, and, presto! all men were equalised in the chewing department. Machinery was gradually advanced, and those who formerly stood no chance of survival were now among the elect. Hand and brain now perform the task of the jaw, and prognathous jaws and tusked teeth have gone out of fashion, because man will never again do what machinery can do for him.

Any return to the hard food of our ancestors would again terminate the chances of the weakly, and, doubtless, in a few generations, our teeth would resume their pristine beauty, and our jaws regain their old strength. We thus see the effect of cooked food on the evolution of man. Why should we regret leaving any aids to a savage life behind? What was a necessity for primitive man was found practically useless by his descendants. He was little more than an animal among animals. He must contend for his food with the cave bear and the hyena. He had no tools and no weapons. He must use his teeth as formidable weapons; and he certainly was formidable. Our feeble jaws give us no hint whatever of what might be done with such instruments. Our posterity may be as independent of the chewing apparatus we possess as are we of the mouths of early man. Civilisation gives the jaw new uses; more especially complex vocalisation, and a general servitude to the brain. Formerly the brain looked out for and waited on the jaws. The same change has gone on with all the senses. The eye can see small things better; but remote things less perfectly. The nose has lost its alert power to distinguish an enemy's approach. The hearing is also modified in its uses, so that while we no doubt hear some sounds more accurately than savages, we are unable to translate the meaning of many others. There are either enlargements of our senses, or wholly other senses which we know nothing of, possessed by animals. The elephant discovers hidden springs of water by some sense possibly of hearing or of smell, and digs sometimes 3 feet to reach them.

The sense of taste associated with the jaws is largely modified, and with it the jaws themselves. Taste has become æsthetic. We care more for flavours. Imagination has a great deal to do with what we eat. The senses in serving the brain all work together. What offends the nose

we cannot endure on the palate. Indeed, association goes far to disturb appetite. No savage cares to reject a piece of meat because it is the flesh of dog or cat, any more than of cow or lamb. Our whole cuisine is supervised by imagination. Millions in Africa live largely on locusts and grubs; but in other countries farmers starve with locusts so plentiful that they destroy all other food. The jaws have thus very little independent action, as taste is no longer an independent sense. A hundred other ideas precede that of hunger, and dominate the taking of food.

The tendency has been all the way to the use of more delicate foods, prepared with more attention to flavours and seasoning. The mouth is concerned in tasting rather than in chewing. To eat has often been designated as an animal affair, to be hidden as far as possible by other ideas, and by such associations as conversation, flowers, beautiful dishes, and aromas. The contrast between a meal served in our best of fashion and a banquet by primitive men is absolute. We not only reject their bones and marrows and decaying flesh, but we hide the fact that we must eat at all.

Shall we give up the teeth, and let the jaws narrow down until they can be of use only for swallowing and for articulation? Are we really readjusting ourselves to higher conditions of life, in which teeth will have no part? Why may we not in time come entirely to the use of liquid or gelatinous foods, that will require no chewing at all? We prefer to put this in the form of questions, for prophecy is reasonably looked on with suspicion. A recent traveller says of the Yakoot: "I have seen adults eat 40 pounds of meat in a day." Nothing is more certain than that civilisation, enlarging the brain, has enabled us to get on with far less animal heat; and so with less gross food. Our jaws narrow as our foreheads widen. Two incisors, two premolars, and one molar on each side have been lost since the earliest races of anthropoids began to people the earth. Is it in the line of higher evolution to let this process go on without effort to counteract it? Prof. Newman says:—"The true test of anything being natural to man is his more mature, not his immature, era. He is a progressive being. Flesh meat helped him through his less developed state; but to attempt to keep up in the latter and more developed stage the habits of the earlier and ruder is pernicious. The diet of flesh meat belongs to the time of barbarism—the time of low cultivation, and thin population; and it naturally decreases with higher cultivation." This is largely an economic question, and resolves itself into this form: How can we obtain and use food with the least expenditure of force and time? Economically, is the savage at an advantage over the civilised? Some one has recently made estimates showing how many hunters and fishers and people in lowest savagery could inhabit a given quantity of land.

Approximately, we know that the whole globe could not to-day sustain 50,000,000 of hunters. Pastoral people, we learn, average 140 to a tract of 20 square miles. But a farming population of 2,260, on the average, occupies easily the same space. The population of the globe, estimated at 1,487,600,000, makes about 31 to every square mile of available area of earth surface. That is to say, to support the world's present population in the savage condition would require the superficial area of the planet Saturn. We reach the momentous conclusion that, notwithstanding the immense regions still overrun by savagery, the population of our globe is already 620 fold what would be possible at a grade of civilisation no lower than that of the civilisation of the American Indian. It further appears that the reduction to savage condition of 30,000 persons would imply the necessary reduction of that population to five individuals.

Here we get at the general fact that our new conditions of life are really a great gain over those of primitive times; that we do not only get our food vastly easier, and far more of it, but that this food is really, on the whole, better for us. The drift, whatever it may do with our teeth and jaws, is making us healthier and happier. As we get away from the carnivorous era and the age of teeth, we are not losing ground, but gaining.

Probably the earlier stages of progress of the human being consisted in achieving mastery over other animals, and in using them in part for food, and in part for draught, and other domestic purposes. Savages could not be agriculturists, but must be hunters. It was necessary in the brute-force struggle to get the upper hand of the cave bear and the wolf. In this process man tamed the wolf, and gradually evolved the dog. The wild ox grew to be the meek-eyed cow. Steadily, however, progress led on to agriculture. The hard fruits grew to be succulent. Vegetables largely displaced fish. The art of cooking softened the grains of barley, corn, and wheat. We can eat with less and less of labour. It is not, therefore, quite an idle question whether we are at the end of evolution in food production, and in our physical adaptations to the same.

There is nothing chimerical in supposing a vast evolution in the production of food: and in readjustments of the body to receive and assimilate it. As we have already hinted, we believe the time not far remote when the bulk of food will be directly created in our laboratories, from the elements now stored in air and rocks and soils. The progressive change involved in this conception of production must be imagined rather than put in definite figures. But anyone knows that the phosphatic rocks are practical food material; only that material has now to go through a long-continued process to fit it for human use. The rock must first be slowly disintegrated by water and air and frost and heat; the disintegrated parts, in chemical combination, must be then slowly taken up in vegetable life. This having been, for the most part, re-worked as animal life, is thus ready for human use. Some portions we take on the way, as cereal or as fruit. Imagine an immediate reduction of these elements, in the course of a few days, from rock to assimilable food. And yet chemistry promises us that in due time she will do this for us.

We are now probably less startled at the question, "Shall we calmly face the requirements of progressive life, and give up our teeth, and anticipate further readjustment of the jaw to the demands of intellectual life?" Will it help us somewhat if we study the evolution of teeth, and notice that some other creatures have already gone through the teethed era, and are existing very comfortably and very beautifully without the possession of any such organ. The birds of our epoch are entirely without teeth; but that was not the case with those of early epochs. Toothed birds were the prevailing type after the saurian age: but there were certain superior advantages possessed by the toothless; and the former passed out, while the latter multiplied. In the fishes the teeth do not occur always in the jaws, but sometimes on the tongue, or on the pharyngeal bones: indeed, on almost any bone.

The tooth was an adjustment of a late day in animal life; and it was palpably a temporary affair. It is not at all certain that it is a requisite to a highly organised anthropoidal being. On the contrary, the present birds are far higher in general organisation and function than the toothed sorts; it is equally possible that toothless races of mankind might rank far ahead of any that now exist on the globe. Our own teeth are not only less in number than those of

primitive men, but are less prominent. The jaw was then prognathous, that is, prominently thrust forward ; and the teeth were not only bolder and harder, but accompanied by tusks. These are now shortened up, and in most cases modestly concealed inside the lips. Few people think of their eye teeth as the natural successors of very savage ripping tusks.

Cooking has had its share in leading to a modified jaw and teeth. It is no longer nccessary to chew very much. The Cave Dwellers, 100,000 years ago, knew how to roast meat, for there are numerous hearths and half-charred bones found among the remains of their feasts. The bulk of their feasting was, however, the devouring of raw meat. No vessels are found indicating that they knew the act of boiling during the old stone period. Somewhat later they seem to have had the art, now practised by some savages, of heating water by dropping in heated stones. In the savage state, undoubtedly, raw meat torn by the teeth and bones gnawed were the better food, with roots and nuts, also cracked by the teeth. It was primarily necessary to have strong jaws adapted to the exigencies of wild life and hard luck, as well as contests with beasts. The bite of a savage is as dangerous as his blow. A cooking stove would actually have put primitive man at a disadvantage in the struggle for existence. Inventions come always fast enough. But without cooking the bulk of the foods we now use could not have been used at all—especially those composed principally of starch, such as grain and potatoes. These, when used uncooked by savages, were valuable mostly for bulk and distention.

Education under civilisation has enlarged the brain power fourfold, and in like ratio has refined the features. The jaw as a crunching, grinding power is little needed. We leave it to our readers to imagine the possible changes that will still take place, and how the future man will look when the food problem has been mastered. We shall, at least, leave him pictures of our own faces, which he will probably smile at, as indicating a low stage of evolution, precisely as we look at the jaws and skulls of the cave epoch.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers

PRIZES FOR THE WEEK ENDING AUGUST 6th.

The senders of the first twelve letters, opened by us on Monday, August 8th containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, August 8th, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 2nd proximo. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page i. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors or the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

AWARDS.

We have received 98 solutions for the current week. The largest number sent in by one competitor being 30. We have duly forwarded the awards to the successful competitors.

*** The Coupon will be found on page i.

SALE AND EXCHANGE COLUMN.

Tariff: First 20 words or less, 6d. Every additional 3 words, 1d. If replies are to be addressed to the office of "Science Siftings," a charge of 3d. will be made for booking and forwarding replies

Rapid Rectilinear, half plate, 7½ in. focus, movable hood, Iris diaphragms, splendid lens, new, 18s. L., 8, Kenilworth-road, Willesden-lane, London, N.W.

Instruments scientific, telescopes, microscopes, spectroscopes, cameras, stands, transits, chronometers microscopic slides, sundries, astronomical instruments. Lists 3 stamps. Observatory, Liversedge, Yorkshire. 2

Electric Lamps. Small incandescent, with printed instructions for use. Post free. 7 stamps. P. Rowsell, 1, Walcot-square, London, S.E.

Quarter plate hand Camera, automatic, for 12 plates, leather covered, good lens, roller blind shutter and finder, complete. Splendid condition. Price 28s. A. Mercer, 16, King-street, Sparkbrook, Birmingham.

Micrometer, for measuring distances, fitted to any telescope, 5s.; can remain in telescope, or taken out at pleasure. Wm. Nicholl, Roslea. Clones.

"Induction Coils."—A practical manual, 3s. "Electroplater's Handbook."—A reliable guide, 3s. Bonney, Avenue-road, Lewisham. 2

S. R. Bonney. 25, Avenue-road, Lewisham. Electrician and Electroplater, Supplies all electrical goods at reasonable prices; send stamp for list, stating requirements 3

Electro-deposition of gold, silver, copper, nickel, &c, by A. Watt. Large edition. cost 12s., will take 7s. 6d. also

Practical Electricity, Prof. Ayrton's (F.R.S.) in good condition. Same as used at "City Guilds." Wanted cash offer.—Also

Johnson's dictionary, published by Virtue ; illustrated, good condition. What offers? Willatt, 51, Salcott-road, New Wandsworth, S.W.

Pocket Accumulator, electric pin, switch and battery to charge it. Only 20s. H. C. Lyon, 616, Mile End-road, London, E.

Dynamo for sale, or exchange, best finish, perfect, £2. Autos, 14, Holborn-viaduct.

Electric machine wanted, with power indicator. Exchange gold Albert, or cash. Lush, York-street, Ramsgate.

A large case of British moths and butterflies for sale, cheap, must be sold, a bargain. J. Russell, 17, Devonshire-terrace, Child's Hill, Hendon.

Wanted, pair strong field glasses, in case and sling, must be cheap, or would exchange pair of gold framed short sight spectacles, L. Kingsmear, Little-park, Enfield.

Wanted, tourist glasses, with case. State maker and price. Norman, Mottram, Manchester.

Wanted, Decondin's perfect photometer, must be in good order, and sent on approval. State price, money deposited if required. W. J. P. Sherwen, Hensingham, Whitehaven.

Bargain. ¼ plate camera, Lancaster's Instantograph complete, including cases, 26s. Approval. Avonleigh, Stoke Bishop, Bristol.

Half-plate camera, 2 lenses, instantaneous shutter, double dark slide, and mahogany folding tripod, 70s. S. J. Smith, 17, King's-place, Portman-square, London.

½-plate mahogany bellows camera, rack extension, double dark slide, folding stand, new condition, 35s. Buckley, Brown Lodge, Smithy Bridge, Manchester.

For sale, a bargain. 10 by 8 field camera, by Watson and Sons. High Holborn, has double extension bellows 24 in., reversing back, double swing, rising front, and 5 double slides, with carriers for smaller plates. Cost £17; will take 7 guineas cash. E. Faulkner, 14, The Common, Woolwich, S.E.

¼-plate set, all accessories, cost recently over £3. What offers? Seen any time. 85, Dalberg-road, Brixton.

Wanted, good R.R. lens, ½-plate, first class maker, cheap. Approval. Martin, 75, East-road, West Ham.

Save your trousers by using the patent heel preservers Instantly applied. Universaliy approved. 7 stamps, 3 pairs for 1s. 4d. Masters & Co., 13, Size-lane, London, E.C. 2

Larvæ-Russata, Plecta, Lucipara, Adusta, Libatrix 1s. doz. Hamula pupæ, 6d. each. Postage extra. Rev. G. H. Raynor, Panton Rectory, Wragby.

Medical Electro battery (Gregg's), with appliances for body, for sale. Original cost, £8 8s. What cash offers? No exchange. H. R., 31, Westbourne-park-villas, Paddington, W.

£20 TOBACCONISTS COMMENCING.

Illd. Guide, 229 pages (3d How to open respectably; £20 to £1,000." "Tobacconists' Outfitting Co." (Reg. 186, EUSTON ROAD, LONDON.

N.B.—H. Myers' pamphlet on Various Trades post free. Mgr. Hy. Myers. Est. 1866.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6 ; ½, 3/8 ; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*, 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, AUGUST 13, 1892.

SCIENCE NEWS AND NOTES.

"Look round the habitable world: how few
Know their own good, or, knowing it, pursue."
—DRYDEN.

The Prize We Are Offering

for the suggestion of an appropriate title to replace SCIENCE SIFTINGS has not yet been gained by any competitor. The proposals that have been sent in do not by any means meet with our approval. However, in this competition, there is no limit to the number of attempts that may be sent in. Therefore, those who have failed may try again to earn the guinea that we intend to award for a really good title. Competitors have run away with the notion that the word "Science" must be included in the title. This is not at all essential. Many people who would enjoy reading SCIENCE SIFTINGS associate the word "Science" with everything that is dry and uninteresting. Therefore, they look at the cover, and are afraid to glance at the contents. These are the readers we desire to catch with an alluring title of a general nature that will embrace everything of interest to mankind. We, therefore, ask you to write your idea boldly on a post-card, with your name and address small underneath, and mail it to us.

Our Article on Electric-Belt Quacks

has received the entire approval of our readers and the general public, if we may judge by the tenor of the many letters we have received on the subject. SCIENCE SIFTINGS is the only paper with a public circulation that has had the courage to publish this exposure of quackery, but we trust now we have taken the first step that the general press will step into the breach and assist in circulating the facts that the so-called electropathic belts are more likely to kill than cure, and when these contrivances of torture, as the evidence published in our columns last week fully proved them to be, are prescribed by unqualified practitioners—they are never prescribed by qualified men—that, at least, an aggravation of the complaint may be anticipated. It will, no doubt, interest many who have paid several guineas for an electric belt to learn that they are sold wholesale for a few shillings. We would recommend our readers to peruse on another page what a technical contemporary has to say about the matter.

Paper Money as a Medium of Infection

was recently referred to in these columns, and pretty generally ridiculed by our lay contemporaries, although we had the entire medical press with us. The *Lancet* now publishes the results of an examination of the notes of the Bank of Spain current in Cuba which has recently been conducted by Drs. Acosta and Rossi. It shows that this form of currency is indeed liable to contain septic germs. The notes chosen for the experiment were some that had been in use for a good while, and were such as represented values of a few pence only. It was estimated that two notes, weighing altogether about 15 grains, contained more than 19,000 germs of various kinds. Cultures were made in broth, gelatine, and agar, and these were injected into the peritoneal cavity of rats and guinea-pigs, most of which died within 24 hours, the post-mortem examination showing signs of peritonitis and congestion of the liver and kidneys. The blood of the heart and peritoneum was made use of to inoculate solid media, in which colonies developed so rapidly that it was impossible to determine their precise nature, many different forms being intermingled. These experiments leave the danger of paper money in times of epidemic beyond dispute, and it remains to be seen what steps the authorities will take to counteract the risk. We would suggest the substitution of metal for paper tokens.

Cold Bathing

in the early morning has been frequently recommended by us to those persons who have sufficient vital energy and nervous force to insure good reaction with no subsequent languor or lassitude. However, many persons who are greatly refreshed by their morning bath, feel tired or languid two or three hours after it. When this occurs, it is conclusive evidence against the practice. Persons who have an abundance of blood and flesh, who are lymphatic or sluggish in temperament, and whose nervous force is not depleted, can take the cold morning bath to advantage. Others who are inclined to be thin in flesh, whose hands and feet become cold and clammy on slight provocation, who digest food slowly, and assimilate it with difficulty, who are nervous and who carry large mental burdens, should avoid early morning bathing. For all such a bath—in which some stimulating agent, such as Heppell's Poudre Adoucissante has been dissolved—at noonday or before retiring at night is far more desirable, and it should be followed by rest of body and brain until equable conditions of circulations are re-established. Some individuals who are weak in nervous power have such excitable peripheral nerves that they get at once a perfect reaction from cool bathing, but lose in after-effects more than the value of the bath. This class of persons should not bathe too often, and should always use tepid water, choosing the time preferably before retiring.

Extraordinary Heat

is now being experienced in America. Ninety-six and a half degrees in the shade is quite common, while 100° is frequent, and at Philadelphia, a few days ago, 104° in the shade was registered. In the streets 110° of heat has been

endured ; the result has been that hundreds of people have been laid low by sunstroke. Although we need hardly fear this extreme temperature this side of the Atlantic, nevertheless a word of warning will not be out of place. Careful inquiry into the habits of victims from sunstroke reveal the fact that quite a large proportion drink to excess before they are overcome by the heat. It is even frequently stated in lay circles that a man who never drinks to excess is in no danger whatever of a sunstroke, and there is a great deal of truth even in this somewhat exaggerated statement. Hot drinks, such as tea and coffee, are not so tempting in extremely hot weather as iced drinks, but, when well prepared, they are invigorating as well as refreshing, and by promoting perspiration they remove all danger of sunstroke, the first symptom of which is always a dry, hard skin, without a particle of moisture. Sunstroke patients, where there is no ice, have been saved by the liberal use of very hot coffee, although, no doubt, the remedy is a dangerous one, only to be justified by the emergency.

A Congress for Experimental Psychology

will soon be held in Berlin. Scientific specialists in criminology, medicine, insanity, law, anthropology, and sociology will all assemble to consider the application of scientific methods to study the relation between mind and body, or mind and brain, subjects of much interest and importance in the case of criminals and of normal men. This is illustrated by the new psycho-physical instrument called the plethysmograph, which indicates the least increase of blood in the arteries of the arm. Thus it has been found that when the sentence of the judge is read before the criminal, there is a decrease in the flow of blood in the arm, but the sight of a glass of wine increases the flow ; when. for example, it is required to multiply nine times seventy-three an increase in blood-flow is the result. The flow is little affected in a brutal murderer or born criminal when a pistol is shown to him, whereas in the normal man the plethysmograph indicates a decided effect. The importance of this new instrument lies in this, that involuntary testimony is given as to the nervous and physical nature of the criminal. It is often unknown to him, and in spite of himself.

The Study of Psychology

has a strong advocate in Dr. James Cuming, of Queen's College, Belfast. He has long been of opinion that some knowledge of psychology proper—that is, of the science of the phenomena of mind in its normal conditions—is absolutely necessary. Without an acquaintance with the problems and methods of psychology inquiry it is impossible for medical men to observe and to describe adequately the phenomena of morbid mental states. In the investigation also of those conditions in which the disturbance of a single function is what is most manifest and striking, it is clear that a knowledge of the limits of differentiation of function must be of capital importance. Dr. Cuming has little doubt that the study of morbid and limited and incomplete mental and cerebral manifestations will throw a great deal of light on some of the most abstruse questions in the relations of matter to mind. It will be bringing into action the logical method of difference, and ascertaining the influence of the removal of part of the cause on the effect. The amount and quality of work done in this direction justify the hope that psychology as a natural science will take its place beside physiology, and that the physical basis of mental activity will be more and more understood and elucidated.

Mr. Herbert Spencer,

our most eminent psychologist, attributes an importance to the circulation in the brain, which, however, physicians would be inclined to regard as excessive. He states that quickening of the circulation in the brain causes a rush of unusually vivid ideas and makes the memory more distinct than usual. He contrasts the illusions of delirium as exemplifying the extreme vividness with which revived feelings may rise when the cerebral circulation is excessive, and the loss of consciousness caused by cerebral anæmia as exemplifying the converse result. Now we have ample opportunity of knowing that anæmia is a fertile source of delirium, as the term "inanition delirium" indicates, and while there is much that is doubtful in that most obscure chapter of pathology which deals with hyperæmia of the brain, we know that it is at least as likely to produce somnolence and coma as it is to produce illusions. If the rapidity of the blood-current were so potent as Spencer supposes physical exercise ought to heighten the receptivity of impressions and there would be even a perceptible increase in the erect as compared with the recumbent position. As a matter of ordinary observation it is found to be difficult to collect our thoughts when the circulation is much accelerated by rapid exercise and hardly possible to carry on a train of reasoning requiring any considerable effort of memory.

Death Watches

with their mysterious knockings are usually a source of mystery to the uninitiated and imaginative, but an investigating naturalist has robbed them of any spiritualistic portent A Parisian chemist has just secured two small insects taken in the act of nocturnal rapping. They were upon the same sheet of packing paper (strong tarred paper), but on the opposite sides and at a distance of about four inches apart. One struck forcibly with its head at the rate of six blows per second, and the insect on the lower side answered as soon as the other had finished. The insect is the *Anobium tessellatum* of Fabricius, a coleopter of the family *Ptinidæ*. The habits of this insect have been well studied by Becker, Taschenberg, and other authors. It is generally during the night that it produces the ticking sounds in question, and as, in order to hear these, we must not go to sleep, and as usually when we do not sleep we are more or less inclined to be melancholy, the *Anobiums* have been named death watches.

In Order to Produce the Blow

the insect draws in the antennæ and intermediate legs, and, resting principally upon the median legs, strikes its head against its support by a sort of rocking motion. It is through this noise that the male calls the female. The larva of the *Anobium* lives in wood (framework, old furniture, etc.) which it gnaws in the interior without anything outside betraying its presence. On reaching its complete development, it hollows out a cavity and becomes transformed therein into a chrysalis. The perfect insect comes forth a few weeks afterward, and makes its exit from the wood by boring a perfectly cylindrical hole in it, which thereafter shows that the wood has been attacked ; and it is often attacked to such a degree that every remedy is useless. A species of the same genus, but smaller (*A. paniceum*), attacks not only wood, but also books, herbaria, natural history collections, cork, dry bread, biscuits, etc. The *Anobium pertinax* also is also very injurious. Its specific name is due to its persistency in feigning death when it is siezed. This simulation is such that when immersed in

water, and even in alcohol, the insect remains perfectly immovable. It would rather allow itself to be burned alive than betray itself.

Walking on Water

was referred to by us in a recent article on impracticable inventions. We mentioned a gentleman who essayed the feat without making due allowance for his personal equilibrium and was nearly drowned in consequence. However, the feat does appear to have been accomplished, for a correspondent writes :—Capt. Terry and Prof. C. W. Oldrevie, two Englishmen, both of whom used specially made floats, succeeded in walking on water. Capt. Terry in 1889 walked on the Thames from Barnes to Mortlake at the rate of nearly four miles an hour and intimated an intention of walking across the channel from Dover to Calais, but that walk has not yet come off. Prof. Oldrevie, who is the champion water walker of the world, has made several successful exhibitions of his power. He successfully breasted the Niagara rapids, walking on the rapids through Hunter Falls in the presence of more than 5,000 spectators. He also performed a daring and dangerous feat in Boston Bay on July 27, 1889. On that occasion he started on a trial trip across Hull Gut. Three or four harbour boats passed near him and he was obliged to take their wash, but notwithstanding this he accomplished the feat easily in fifteen minutes, the distance being about a quarter of a mile. Then the Professor was taken into a steam yacht which steamed away with him for his next trip. He was lowered into the water and at once turned his face toward the mainland. So rough was the sea that the breakers hid him from view nearly half the time. The yacht followed as closely as possible, her occupants momentarily expecting to see the Professor disappear beneath the surface and never rise. After a plucky struggle a distance of five miles was successfully covered, and Prof. Oldrevie made a successful landing at a point near Strawberry Hill. The wooden floats on the Professor's feet were square boxes of cedar, 4 feet long, furnished at the top with a recess for the feet, and in the bottom with a series of collapsible paddles, hinged to swing horizontally, and on the backward push presenting a flat surface like the membrane of a duck's foot.

How Cookery Civilises

was dealt with very extensively in our last issue under "Social Science," and in this connection now come some observations from Dr. Lewis G. Jones. He draws our attention to the fact that civilisation received its primary impulse, and has achieved its most notable successes, in the temperate zone, and among races which are neither exclusively vegetarian nor exclusively carnivorous in their habits. The modern American and European, as is well known, is a descendant of one or more branches of the ancient Aryan or Indo-European stock. It so happens that one branch of this stock which early separated from its European cousins and travelled southward to the mountains and plains of India, through stress of climatic and religious influences, became as nearly exclusively vegetarian as any large section of the human race has ever been, and has remained so for centuries. Here, then, is an opportunity for comparison. The effect of the vegetarian habit, superadded to climatic conditions, has been to develop a race notable, indeed, for some of its intellectual traits, but inferior in size, lacking in physical stamina and energy of character, whose millions of people easily fell a prey first to the Mahommedan and afterwards to the English, whose commercial enterprise for centuries has proved inferior to that of the small competing race of the Parsees —their nearer blood relations—and which has shown itself lacking in those essential traits which characterise our modern, progressive civilisation. The great and successful men of all ages have been those who have not departed too widely from the mixed diet which has long constituted the habit of the races which have peopled the temperate regions of the earth. This is practically what we contended in the article already referred to, and we are pleased to find our theories borne out by facts.

An Interesting Note for Agriculturists,

gardeners, and others is conveyed in the following communication from abroad. The writer says :—"During this hot, dry weather every foot of ploughed land should be kept well stirred on the surface with any tool which tends to keep it from baking. A loose, fine surface will hold down water like a wet blanket. A field kept thus may give an increase in crop over one not cultivated equal to that produced by a heavy application of fertilisers. Preservation of the soil-water thus becomes of great importance. A blanket of fine soil on the surface during a hot, dry week can be of great value to the crop, and really become the turning-point for profit, if present, when loss might result from its absence."

Some Magnificent Natural Phenomena

were recently observed by a party of scientists who were ascending Mount Painier, a peak 14,440 feet high, in Washington, U.S.A., where it is intended to establish a meteorological station. "While the party was camping some distance below the summit," writes a member of the expedition, "we were awakened by a loud crash of thunder. The lightning leaped from cliff and crag below and above us. A gentle fall of rain followed—gentle because we were above the great mass of the clouds. After an hour of thunder and rain, one of the party who ventured to look out said, 'It is going to clear off, for I see two stars shining.' But his attention being attracted by a peculiar hissing, he was led to investigate. The two stars proved to be balls of St. Elmo's fire gathering upon the ends of two alpenstocks stuck in the snow not far away. Chancing to raise our hands, we were surprised to see our finger nails illuminated and to feel a slight tingling sensation as the electricity passed down our arms. Our tin drinking cups glowed with this strange fire like coals within the grate." Rainier is an extinct volcano, but among the Indians there are many traditions of eruptions. The old crater is still filled with hot springs, and the escaping steam raises the temperature in sheltered places there to 110 degrees Fahrenheit. On clear days the cloud of steam has become visible, and has now and then given rise to the report that the volcano was again in a state of eruption. Colour has been lent to such rumours by the slight earthquake shocks which occur two or three times a year.

Some Interesting Prehistoric Drawings

on stone have just been discovered by a Mr. Flamand in the south-eastern part of Algeria. The stones exhibit pictures of men, women, and children, as well as the figures of horses, cattle, ostriches, and elephants, although the elephant has not inhabited this region within historic times. No clue has yet been found to the identity of these people, who are evidently neither Berbers, Arabs, Romans, Vandals, or Visigoths. The designs bear considerable resemblance to Egyptian figures.

GLEANINGS OF THE GLOBE.

Live fish have been sent in safety in the mails from India to England.

The atom is the unit of the chemist; the molecule the unit of the physicist.

In all the Japanese empire, with its population of 237,000,000 it is estimated that there are fewer than 10,000 paupers.

The National Cooperative Festival will be held at the Crystal Palace, on Saturday, the 20th inst. The attractions are to be very numerous.

The authorities in Berlin have determined to cremate all paupers who may die while being a public charge. We thought this was a rich man's privilege.

We have received from Messrs. Hazell, Watson, & Viney, a copy of *The Amateur Photographer's Annual* for 1892. It forms a comprehensive epitome of progress in the science of photography for the past twelve months, and is well illustrated.

Birds are able to work at a higher rate than any other animal—that is, they can develop more energy in proportion to weight by working at a higher temperature, and this necessitates a warm coating of feathers as a protection from the cold atmosphere.

We quote the following from an American paper:—"Dr. Keeley has sold to the British Government the absolute right to his 'cure,' and he has pocketed half a million dollars therefrom." We have no hesitation in giving an unqualified contradiction to the statement.

The diving apparatus is one of the latest objects to which the telephone has been applied. A sheet of copper is used in place of one of the glasses in the helmet, and to this a telephone is fixed, so that the diver, when at the bottom of the sea, has only to turn his head slightly in order to report what he sees, or to receive instructions from above.

The Great Lakes of America are wonderfully productive so far as the yield of fish is concerned. A careful estimate, based on the known production in 1880, 1885, and 1889, shows that in the decade terminating with the census of 1890, over 1,000,000,000 lbs. of food fish were taken, which yielded the fishermen over 25,000,000 dols. (£5,000,000).

Some interesting experiments with regard to the action of light on sulphate of soda have recently been performed by Mr. W. H. Sodean. The salt was prepared by passing sulphurous anhydride into a solution of recrystallised nitrate of silver, washing the precipitate thoroughly, and completely desiccating by keeping it in a vacuum over a mixture of sulphuric and chromic acids. When kept in hermetically closed tubes it was slightly blackened after a fortnight's exposure to sunlight. When the temperature was raised the blackening was more intense and more quickly brought abont. It was noted also that when moisture was present the darkening was accelerated.

Between Paris and Berlin mail matter is now transmitted in 35 minutes by the pneumatic process.

A florist says that the law governing the colouring of flowers makes a blue rose impossible. According to this law, the three colours, red, blue, and yellow, never all appear in the same species of flowers; any two may exist, but never the third. Thus we have the red and yellow roses, but no blue; red and blue verbenas, but no yellow; yellow and blue in the various members of the viola family (as pansies, for instance), but no red; red and yellow gladioli, but no blue, and so on.

A wonderful deposit of fossil plants has been discovered in a railroad cutting at Mansfield, near Pittsburg, Pa. (U.S.A). There, packed in the solid blue and black shales, are the abundant remains of the vegetation of the carboniferous age. Perfect casts of beautiful arborescent ferns and calamites, rushes of gigantic length, and curiously carved trunks of the lepidodendron and sigiloria are all heaped and pent in one inseparable mass. Even the unlearned Italian labourers are amazed at the sight. On every block of shale are 1,000 perfect casts of plants and 100 different varieties.

Sir Robert Ball foretells great things for the spectroscope as a revealer of movements in the heavens unappreciable by any other instrument. We talk of "fixed stars," but there is in the heavens no real permanence. As he says, the motion of the fixed stars have been known for centuries. In a thousand years the Great Bear will not seem to alter much, but in 20,000 years it will become disturbed at its present rate of change, and in 100,000 years it will hardly be recognised. The spectroscope in its newest application puts into our hands the means of estimating the speed at which the stars are moving.

A Leith boatbuilder is constructing a yacht which he claims is unsinkable and uncapsisable. Owing to the manner in which the fore and aft sections, which are conical in shape, are permanently and hermetically sealed, the boats are rendered unsinkable, even if filled with water, as the water runs back into the sea through the opening in the centre board casing. The cruising yacht he is about to build will be of aluminum alloy. The yacht, which instead of being painted will be polished, will be about 32 feet long and 8 feet broad, and will be provided with a roomy cabin panelled in oak, and a commodious forecastle. All the deck fittings, as well as a centre board dingey which will accompany the yacht, will be made of the same white metal.

As a specimen of what selection will do, it may be observed that roosters and hens among the Rucuyenne tribe of Indians, in the western part of French Guinea, are perfectly white. Not a coloured feather can be found among them. The natives have no tradition of a time when their ancestors had fowls of other colours, but the white chickens are probably explained by the fact that white feathers are the choicest ornaments among this people, and they will not wear feathers of any other colour. In fact, their fowls are raised more for their feathers than the cooking pot. It is supposed that a long time ago, when their ancestors chose white as their favourite colour, they gave the preference to those fowls which were nearest white, reserving the others for the cooking pot, and by constantly breeding from fowls that were white or nearly so, the present breed of chickens was evolved.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 41.

169.—What are the sparks due to, and what do they consist of, that result from striking together flint and steel?

The sparks are due to the combustion of steel. Small fragments of this metal are torn off by the concussion, and are at the same time sufficiently heated to cause them to take fire and burn by combination with the oxygen of the air. The product of this combustion is a solid substance in the form of minute grains of oxide of iron, or what is commonly called *rust*.

170.—Is there any physiological cause, apart from fear, that accounts for such optical delusions as seeing ghosts, spectres, etc.? If so, why should these appearances always present the white colour belonging to conventional ghosts?

Apparent distortion is the natural result of an attempt to view any object that is very difficult to be seen by reason of the small amount of light with which it happens to be illuminated. The imperfect view which we obtain of such objects forces us to fix the eye more steadily upon them; but the more exertion we make to ascertain what they are, the greater difficulties do we encounter to accomplish our object. The eye is actually thrown into a state of the most painful agitation; the object will swell and contract, and partly disappear, and it will again become visible when the eye has recovered from the delirium into which it has been thrown. Another cause of uncertain and varying vision, in a very subdued light, exists in the fact that, in this circumstance, the pupil of the eye expands nearly to the whole width of the iris. Thus expanded, it is able to collect a larger quantity of the feeble light which prevails; but this is at the sacrifice of what is called the power of accommodation, or the capacity of the eye for self-adjustment to the conditions in which near objects are seen distinctly. Hence the forms of persons and things thus seen become most shadowy and confused when they come within the very distance at which we count upon obtaining the best view of them. It is not surprising that unnatural and grotesque "spectral forms" are apt to present themselves to the mind while the organ of vision is in this abnormal state. And the fact that such forms are usually white is a simple consequence of the light under which they are seen being too weak to illuminate surfaces of any other colour.

171.—How can the presence of electrical radiation be detected?

It is well known that waves of sound of a certain frequency in air are capable of setting into vibration a tuning fork whose period of swing bears a simple relationship to the period of the aerial waves. It is by a similar law of sympathy between *etherial* motions that the presence of electrical radiations can be detected by their influence upon an oscillating electrostatic charge. The detector employed by Prof. Lodge consists of a charged Leyden jar, of which the knobs are brought almost as closely together as is possible without the passage between them of a discharging spark. The size, or, in electrical phrasiology, the capacity, of the jar is so chosen as that the natural period in which the charge that it contains is capable of surging to and fro, may coincide with that of the electrical radiation to be detected. In case of uncertainty as to this, there is no mechanical difficulty in so mounting the jar as that its capacity may be varied within wide limits. Now the effect of electrical radiation upon a jar circuit thus adjusted is to cause the static charge to oscillate or surge to and fro. As the amplitude of the disturbance thus induced in the charge becomes greater and greater, a point is eventually reached at which it bursts across the gap between the discharging knobs in the form of a spark. This, although an indirect one, is perhaps the best method that has yet been devised for detecting the newly discovered form of radiant energy.

172.—Are large clouds formed in bulk at one time, or do they grow by degrees?

A large cloud is generally produced at one time by a condensation of moisture due to the cooling of damp air as it rises in the atmosphere. Increase of opacity and density is generally due to a contraction in the bulk of the cloud. And it should be remembered that the apparent growth of clouds approaching from the distant horizon is usually due to nothing but the ordinary law of perspective, whereby every approaching object casts a larger image on the retina as it becomes nearer. In this way one can understand how a cloud at first "no bigger than a man's hand" in appearance, may by approaching and descending towards the observer, assume apparently disproportionate dimensions.

173.—What is the object of the differential calculus?

This is a branch of mathematics that deals with variable quantities. Unlike algebra, geometry, and trigonometry, which are concerned with absolute quantities only, the calculus furnishes solutions to such questions as when a variable quantity attains its greatest value, when it is increasing, when it is diminishing, when changing fastest, and so on. It is true that an ingenious application of algebra or geometry often furnishes solutions to problems dealing with quantities varying according to known laws, which problems belong, properly speaking, to the differential calculus. But the advantage, even in these cases, in applying the rules of the calculus is that no special ingenuity is demanded for the purpose.

174.—How is the filament of an electric lamp made?

The simplest process is to use paper or cotton thread, treated with a mixture of vitriol and water, so as to convert it into material resembling the so-called vegetable parchment. Suppose that ordinary cotton thread is chosen. After treatment in this way, so that the fibres are compacted, the threads are wound upon a wooden mould, of which the section is of the shape of the filaments desired. Next, the mould carrying the prepared threads is buried in a crucible of finely-powdered plumbago, and is slowly raised to the temperature of bright redness. After cooling, the now carbonised filaments are easily removed from the carbonised (and shrunken) core. They are carefully mounted upon the platinum wires of the lamps. The next step is to "flash" them by passing a current of electricity, so as to heat them intensely while immersed in an atmosphere of hydrocarbon gas, such as coal gas. In this way an outer coating of very hard carbon is precipitated upon the filaments, and they are made ready for insertion in the glass bulb. Exhausting the air from this, and sealing it up, completes the process of manufacturing the glow lamp.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

181.—What are the peculiarities of the reputed "Valley of Death," in the East?

182.—Have pieces of stone ever been known to fall from the air inclosed in hail-stones?

183.—What kind of aquatic animal or vegetable life is it, the presence of which, apparently, turns water into blood?

184.—What is the simplest method of preventing the intoxicating effects of drinking alcoholic liquor?

185.—What kind of fruit is the "apple of Sodom"?

186.—Can any scientific explanation be given of the fact that nutritive "manna" has been precipitated from the sky?

THE ORIGIN OF COAL.

Geology is, from the nature of things, an indefinite science, in so far as its deals with the earlier periods of the earth's existence. Studying the effects produced by natural forces at the present day, it reasons that in the past similar effects argue the operation of the same forces. But even the record of these effects as contained in the portions of the earth's crust explored by the geologist is very incomplete, many gaps being left to be filled in by deduction, always liable to error. Any moment may bring forth some new fact, upsetting preconceived ideas and compelling a remodeling of theories. However, the theory as to the formation of coal now generally held is apparently as firmly founded as any geological speculation, and will probably never have to be materially altered.

Almost all the coal known to and worked by man dates from the Carboniferous age division of the Paleozoic period, taking its name from the extent of its coal formations, and itself capable of subdivision into three minor periods; the Sub-Carboniferous, the Carboniferous proper and the Permian. It is in the measures of the second of these subdivisions that coal is principally found, in seams varying from a fraction of an inch to 40 or 50 ft. in thickness. Under each coal seam is a bed of fire clay; above it a covering of black bituminous slate. A pure, simple seam is rarely more than 8 to 10ft. thick, the mammoth seams being formed by the running together of several seams through the thinning out of the intermediate strata, which are still to be found in very thin layers through these seams. Between the seams, with their accompanying clays and black slate, are layers of sandstone and limestone. A section through the coal measures shows a number of seams of coal, in some cases as many as 50 or 60, of various thicknesses and degrees of purity, separated from each other by intervening strata of sandstone and limestone. The vegetable origin of coal is no longer considered doubtful, and we have the following as the principal evidence upon which is based the present scientific unanimity of opinion on the subject:—

First.—The remains of an extinct vegetation are found in abundance in immediate connection with the coal seams, stumps and roots in the under clay and leaves and stems in the black slate in contact with the seam, and even embedded in the seam itself.

Second.—These vegetable remains are not only associated with the seam, but have often themselves become coal, though still retaining their original form and structure.

Third.—Not only these easily recognisable embedded fragments, but the embedding substance also, the whole coal seam, even the most structureless portions and the hardest varieties, such as anthracite, when carefully prepared in a suitable manner and examined with the microscope, show vegetable cells with characteristic markings.

Fourth.—A perfect gradation may be traced from wood or peat on the one hand, through brown coal, lignite and bituminous coal, to the most structureless anthracite and graphite on the other, showing that these are all different terms of the same series. In chemical composition, too, the same series may be traced.

Fifth.—The best and most structureless peat, by hydraulic pressure, may be made into a substance having many of the qualities and uses of coal.

These are, in brief, the main reasons for the belief in the vegetable origin of coal. Working on this hypothesis, how can we account for the different varieties of coal, classified according to their elementary composition; that is, according to the relative amounts of carbon, hydrogen, and oxygen contained in them, these being the three elements forming a pure coal? The substance that makes up the mass of the cell membranes of all plants is called cellulose, and has a composition denoted by the chemical formula, $C_{18}H_{30}O_{15}$, signifying that each molecule is formed of 18 atoms of carbon, 30 atoms of hydrogen and 15 atoms of oxygen. When vegetable matter is protected from contact with air, as it may be by being covered with water, mud, or a growth of fresh vegetation above it, a slow decomposition takes place by mutual reactions among its own elements. Carbon unites with hydrogen to form marsh gas, CH_4; also with oxygen, forming carbonic acid, CO_2, while hydrogen and oxygen unite, producing water, H_2O. These reactions are proved to take place by the continual giving off of marsh gas and carbonic acid from the coal in mines, these two gases being the fire damp and choke damp, so dreaded by miners. Analysis also shows that the bubbles which rise to the surface when we stir up the decaying vegetable matter at the bottom of a pond are composed of these gases.

Starting now with 2 molecules of cellulose, or $C_{36}H_{60}O_{30}$, by subtracting 9 molecules of CO_2, 3 of CH_4, and 11 of H_2O, we have left $C_{24}H_{26}O$—the formula for an average cannel coal. In the same way we obtain $C_{26}H_{20}O_2$—the formula for average bituminous coal—by the subtraction of 7 molecules of CO_2, 3 of CH_4, and 14 of H_2O; and finally, if we deduct 10 CO_2, 10 CH_4, and 10 H_2O, we have left C_6, which is pure carbon or graphite. Thus reactions known to occur are shown to be capable of producing coal from vegetable matter—another strong argument in favour of this theory.

It is almost certain that bituminous coal has been formed in the manner indicated from the original vegetable matter, without the aid of heat, the strata found with it showing no signs of metamorphism. The extreme varieties of coal, anthracite and graphite, are always found, however, associated with metamorphic rocks, so that it is almost equally certain that in their case heat has played a part in the complete expulsion of the hydrogen and oxygen. Such heat need not be extreme, a temperature of 300° to 400° F. being sufficient to produce all the metamorphic effects found in the anthracite regions.

The origin of the coal thus determined, how can its accumulation in its present form of numerous seams throughout the coal measures be accounted for? This accumulation certainly took place in the presence of water. In no other way can the preservation of the original organic matter which would have decayed if left exposed to the atmosphere,

the presence of interstratified layers of clay, sand, and limestone, or the stratification of the coal itself, be explained. Besides, the plants found in connection with the coal seams are such as grow in moist ground. Opinion, however, is divided as to whether the growth and deposition took place on the same spot or whether the latter occurred at a distance from the original home of the plants, being brought about by the formation at the mouths of rivers of the so-called "rafts." The theory of growth *in situ* seems most probable, agreeing better with the facts of the comparative freedom of coal from ash which is intermixed inorganic matter: the existence on top of the seams of numerous perfect specimens of the most delicate parts of plants and the number of stumps found apparently in the exact condition and position in which they grew in the under clay.

The study of the strata of the coal measures seems, also, to indicate that the forests from which the larger coal beds have been formed grew at the mouths of rivers, on low lands more or less marshy and subject to overflows from the rivers, with occasionally an incursion of the sea due to a gradual subsidence of the continent. The land area of the earth bearing then a much smaller proportion to the water than it does at the present day, the air was more saturated with moisture and consequently the climate was much warmer and more equable; water vapour, from its property of allowing luminous heat rays to pass almost untouched, while almost completely absorbing the dark rays radiated back from the earth, being one of the potent agents in storing up in the earth the heat coming from the sun.

These conditions of constant moist warmth, coupled with the presence of an excess of carbonic acid in the atmosphere, produced a most luxuriant forest growth, continuing for years and forming a constantly thickening deposit of vegetable matter. Now and then an overflow of the river covered this deposit with a thin layer of sand and mud, on top of which a new seam began to form. At longer intervals an inrush of the sea put an end to vegetation and formed a stratum of limestone. But gradually the sediment brought down by the rivers built up on the sea bottom new deltas on which a new growth began and the process was repeated.

Thus by the alternate growth and submergence of vast forests, were the materials destined to produce these deposits of incalculable value formed and stored under the conditions necessary for their future transformation. Slowly, during the thousands of years of the Carboniferous period, did the energy of the sun transform the carbonic acid of the atmosphere into solid carbon; still more slowly through the succeeding eras came the changes bringing this carbon to its present form, and now, after ages of preparation man is "unbottling the sunshine," modifying the rigours of winter and turning night into day with the rays apparently lost millions of years ago.

WATERPROOF sheets of paper stuck together by a special process, and compressed by hydraulic power, have been found in Germany to be material sufficiently hard, not only for the soles of boots, but for horseshoes.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

If you have an idea for a patent, write to the Editor of SCIENCE SIFTINGS, giving the outline of your scheme. The communications will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

ELECTROPATHIC FRAUDS EXPOSED.

MORE ABOUT QUACKS AND QUACKERY.

In order to prove that in our *exposé* of the misleading pretensions sometimes advanced in connection with the so-called "electropathic" belts, we have with us the most respectable organs of the electrical press, we have pleasure in quoting *in extenso* a brightly written article from the *Electrical Review*. Referring to the prestige (save the mark!) of these much advertised appliances, our contemporary says, that it must surely have received a severe blow recently in the Bloomsbury County Court.

"The action, which was the means of completely exposing one of the grossest cases of misrepresentation of the present day, is of special interest to electricians, because the evidence of an electrical expert was, for the first time, we believe, in the history of these so-called electro medical appliances, added to other overwhelming testimony as to their worthless nature.

"The defendant in the action was advised to submit the belt to Mr. T. E. Gatehouse, who reported upon it. It consisted of the ordinary webbing, on one half of which were fixed 12 thin zinc stamped discs, about 1½ inches in diameter, and on the other half 12 copper discs, similar in shape and size, with their surfaces apparently tinned. The discs on either portion were connected up together, in two sets of six, by flexible metallic conductors, so that one half of the belt might be said to contain two zinc, and the other two copper, electrodes. On the external portion of the belt there was a small metal tube or socket in connection with each electrode, evidently with a view of applying electrical energy from an external source; and on the front half of the belt was a suspender with metallic webbing electrodes, connected by indiarubber covered flexible conductors, one to each set of zincs, but as this ornament was superfluous, so far as the patient was concerned, it is unnecessary to allude to it again. It was quite impossible for this belt to generate any current as worn upon the body, for the external circuit was not completed by the connecting up of the zinc and copper poles, nor were any means indicated to the defendant of doing so for himself.

"Assume, for the sake of argument, that one of these belts is properly connected up, and that the exudations of the body act upon the metals so as to produce by chemical action an insignificant amount of electrical energy. Does the current so produced pass through the body, and is it of any use medically? To both questions we reply, practically, No!

"Under the best conditions of producing galvanic currents, such a combination as zinc and copper in a saline solution could not give a higher E.M.F. than 0·8 volt, and as embodied in an electropathic belt of this type the voltage is probably considered less than half the value above given, owing to polarisation and other causes. In the best medical practice (and with this we wish to couple the names of Dr. A. de Watteville, Dr. Arthur Harries, Dr. Inglis Parsons, Dr. Lewis Jones, and Mr. Newman Lawrence, whose kind assistance at various times we cordially acknowledge), applying what is termed constant current electricity from external sources, it is found that any current below 5 to 10 milliamperes is useless for the majority of cases, but in instances where the head forms part of the circuit, so small a current as 1 to 2 milliamperes is sometimes employed.

"The E.M.F. required to develop 10 milliamperes when the average resistance of the human body is in the circuit is

about 15 volts, so it can readily be seen that the current generated by an electropathic belt is but a mere fraction of 1 milliampere. It must be noted, moreover, that the resistance of the body does not remain the same with different E.M.Fs. It is a function of the cataphonic action of the current, hence it diminishes with every increase of E.M.F. of the battery and *vice versa*. Supposing a battery of 10 volts gives a current of 5 milliamperes through a given portion of the body, a cell of 1 volt may give rise to but a minute fraction of a milliampere. Further, the people to whom the same kind of belt is supplied probably vary very much, both in skin properties and tendency to perspire. For instance, a diabetic subject would have a perfectly dry skin. We have always contended that "belts" such as that which was the bone of contention give practically no current, even under the best conditions, and that most, if not all, of the insignificant quantity of electricity generated by such appliances flows along the *webbing of the belt itself* and partly, perhaps, over the *moist surface of the skin*.

"We are not alone in this opinion, but we do not know that any experiment, previous to what seems to be a conclusive one performed by Mr. Gatehouse, just before the commencement of the action, had ever been made to settle this question. The belt was laid flat upon a bench and moistened with a weak solution of salt and water; a very sensitive galvanometer of the P.O. pattern was then connected with the copper and zinc discs and a deflection of 14 divisions obtained. Now if the belt, still connected with the galvanometer were taken and the zinc discs placed upon one leg, the coppers on the other, that portion of the body forms a shunt to the webbing of the belt, and assuming that the current would overcome the skin resistance, the total resistance in circuit would have been much diminished and the current correspondingly increased, but no such result was obtained; the needle remained stationary. So it was when the hands and arms formed part of the circuit, and it was only by deliberately wetting the legs and hands that any higher deflection was obtained, and that only about 4 degs. These conditions were verified in the case of another gentleman who obligingly placed himself at Mr. Gatehouse's disposal. The sensitiveness of the galvanometer was such that 0·8 volt would give the 14 divisions (which represented a current of ·026 milliamperes) through 30,000 ohms resistance.

"It is perfectly evident, therefore, from this experiment that the current which was flowing through the webbing of the belt itself is not increased by contact of the belt with the body when it (the latter) is in its normal state, and not wetted by the external application of liquid.

"This will be very satisfactory information to the medical profession, for doctors can now state positively that the current generated by these appliances does not overcome the skin resistance, and cannot, therefore, possibly influence the body.

"If the much-to-be-pitied individuals of both sexes who so readily fall into the snare set by the president of the *British Association of Medical Electricians*, and of the Medical Battery Company, would only reason with themselves, a few minutes reflection ought to convince the most foolish that the idea of a poor debilitated body generating the electricity for alleviating its own suffering is most preposterous. Indeed the stepping stone from hallucinations of this kind to the borderland of a profound belief in perpetual motion can be but a narrow one.

"Their supposed curative results are fully accounted for by a kind of "hypnotic suggestion" akin to the well-known effects of bread pills on sensitive organisms.

"But having satisfactorily disposed of the electrical pretensions of these patented articles, where can words be found sufficiently strong to condemn the practices carried on in the Oxford-street mansion in the treatment of rupture?

"That it should be possible in these days of enlightenment, and in the midst of the largest city in the world, for 16,900 cases of a serious malady to have been treated by a man having such qualifications for the task as the consulting officer of the Medical Battery Company proved himself in the witness box to possess, is beyond the comprehension of any reasonable being; and if ever there was a matter demanding the immediate attention of the Public Prosecutor the revelations made at the Bloomsbury County Court point to it.

"If the treatment, by an unqualified man, of incurable disorders which require careful and skilful medical attention is not actionable at law, the sooner some bill is passed through Parliament to make it so the better for suffering humanity.

"It is bad enough that the male sex should submit to be "examined" by these so-called "experts," but to think that gentle, refined, and highly sensitive women should be contaminated by the mere touch of such "consulting officers" is utterly abhorrent to the feelings of anybody possessed of a trace of morality or a scrap of manliness.

"We trust that the report of this disgraceful case may be disseminated far and wide, for it will do much to enlighten the public as to the real status of Mr. C. B. Harness, and the manner in which those who read, and are misled by his advertisements, are "examined," if by an unlucky chance they are led to consult the consulting officers of the concern over which he presides. No wonder that he can spend yearly in advertisements a sum which most people would consider a princely fortune, if 16,900 cases are treated at five guineas a time—probably more in numerous instances—in between six or seven years.

"Weight may, perhaps, be still further added to our comments, if we state that Mr. W. H. Preece, F.R.S., chief electrician to the Post Office, to whom, at his request, Mr. Gatehouse showed the belt, has sent him a letter to the effect that so far as he could see from an examination of the appliance, and from the results of the tests, it would be quite impossible for the belt to generate a current of electricity through the body."

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.

Or from Messrs. W. H. Smith & Son,

and through any Newsagent.

AN INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. I, price 1s., post free, 1s. 2d.

Our Monthly Edition.

SCIENCE SIFTINGS may now be obtained in Monthly Parts, bound in buff wrappers. Price 6d., or post free, 8d., of any Newsagent; W. H. SMITH & SON'S bookstalls; or of the Publisher, 78, Fleet-street, E.C.

"SCIENCE" OF LONG AGO.

Some of our readers may recollect that one "Parabola" announced three or four weeks since that if SCIENCE SIFTINGS would offer a prize of £1,000 to whoever should prove that the earth is not round, but flat, "he would a tale unfold," etc. We had much pleasure in acceding to the request made by "Parabola," and he has now his wondrous tale unfolded. We fear his prospect of obtaining the £1,000 reward is but remote. Our astronomer, into whose hands the MS. was placed for review, has conscientiously waded through it, and reports it in every aspect almost hopelessly astray. Under these circumstances, we restrict ourselves to a few quotations that will amuse those who are not of "Parabola's" way of thinking.

In the first place, our correspondent falls foul of the statement that "astronomy is the most exact of the sciences." His criticism could be upheld, although not in the way he put it. As a matter of fact, there is only one branch of physical science that is wholly and absolutely exact, and that is the science of numbers, *i.e.*, mathematics. "Parabola" speaks of the North Pole as "The Mountain of the Lord," and of the South Pole as "The Circle of the Earth." His illustrations are largely drawn from Holy Writ. It is extremely funny to be told that "waterspouts all come from the South, being formed by the action of the water on the bounds of the sea or circle of the earth."

Waterspouts are caused, as most of our readers will be aware, by whirlwinds—ærial vortices or eddies. Our correspondent suggests that the sea "heaps itself up in the endeavour to pass the circle of the earth," and that, in consequence of this peculiar state of things, the inverted (mirage) ship is brought about, "its image passing through the clouds into space, and crossing the valley of death or the vale of tears." "Parabola" says that with a telescope enabling one to distinguish objects, say 20,000 miles away, it would be possible to see (in any latitude) the top of the mountain of the Lord and the circle of the earth." We can only recommend our correspondent to begin the search for these interesting objects at once.

Speaking of the moon, "Parabola" thinks that the appearance of a lunar eclipse is due to the presence of "a burnt-out star" raising the temperature of the moon to a dull red heat! A number of experiments with Foucoult's pendulum are suggested, and remarkable deductions are drawn from the hypothetical results.

Presumedly the writer has not performed the ingenious but simple experiment described under "Prove that it Moves," in page 149, Vol. I., of SCIENCE SIFTINGS. It is disquieting to be told that "when Saturn has thrown out all its lava, it will fall to the earth," particularly since this catastrophe, and other equally curious prelictions are said to be guaranteed by "the Scriptures, the Church of Rome, and Shakespeare." We must refer our correspondent to his spiritual adviser, who would probably caution him against interpreting the Book of Revelations too literally.

We might attempt to convey some idea of how it is that the "proper motion" of the sun through space is not inconsistent with the permanency of the earth's orbit by suggesting a comparison with the motion of a sling whirled round and round in a railway train. It would be found that the orbit of the sling would not be affected by the "proper motion" of the train. But what is the use of arguing in this way with one who speaks of "two huge hollows in America, where the sun and moon rested in the days of Joshua?"

THE SHEPHERD'S STAR.

BY CAMILLE FLAMMARION.

There is no one who has not, for several weeks past, remarked the admirable star which shines with a brilliant light every evening in the western heavens. Of a lustre without rival, the white planet reigns as a sovereign over the land and sea. It can be found by the naked eye, even before the setting of the sun, and several possessors of excellent eyesight are exercising themselves at this very moment in discovering it at noontide, and in following it through the heavens for the entire day. Two readers of this journal write to us that they have succeeded in discerning its phases by the naked eye. At this moment it has the form of a crescent.

In the midst of the agitated life of modern cities which, especially at present, is sweeping the majority of men into a more or less blinding vortex, the glittering star is observed in the evening, only to be as quickly forgotten; but formerly, in the peaceful quietude of the fields or the ancient cities, when life was truer and less rapid, eyes were arrested longer upon the various spectacles of nature and an apparition such as that which is rendering our western sky brilliant was the subject of all thoughts and of all conversation. The question was asked what this movable star, which seemed to dispute its light with that of the sun itself, could be. It had been remarked that it never gets very far away from the orb of day, and its periods of appearance and disappearance had been explained as due to a motion around the sun. Its splendour, its beauty, its lustre, so soft in the vanishing light of twilight, the whiteness of its light at nightfall, and its sovereignty in the sky of night, at the hour of rest, of dreams, and of confidences, have insensibly led to this charming star being designated by the most sympathetic names. Venus was the first star admired, cherished, venerated, and even feared. It is the oldest and most popular of the ancient divinities. From primitive ages the hour in which it brightens up its limpid aspect was awaited by the *fiancée*, who associated the most beautiful planet with the tenderest feelings of her heart. What eternal but ephemeral vows has not this white star received amid the silence of warm spring evenings, at the hour in which the last breath of perfumed atmosphere glides like a chill through the fields and the woods!

The generation of languages somewhat resembles that of things generally. Words are born from impressions and have personified associations of ideas. Venus very naturally became the goddess of beauty and love, white as the light, as perfect in her form as an emanation from heaven, and, sovereign-like, the star that dominates the world. Near the sun, swifter, more undulating, Mercury was a messenger of the sun on a perpetual travel, with wings on the feet, and, later, god of commerce, of industry, of navigation, of sacred research, and of medicine; Mars, of the red rays, active in his celestial travel, symbolised war, strife, and bloodshed. Calm and majestic in his course along the constellations, Jupiter became the supreme god, managing the general order of the world. And, ever there, pale Saturn, slow and without lustre, personified time and destiny. Thus, the very aspect of the stars gave birth to mythology and religions.

The first star set ablaze in the sky, as white as light, as beautiful as the day, divine ray of the first nocturnal hours, how can we wonder that Venus has been personified since the adolescence of the world as the goddess of beauty and love? If some Adam and Eve inhabited the terrestrial

paradise, the morning and evening star cannot have failed to strike their attention, and, from mythological times up to our lamentable century's end, in which the wings of Cupid seem to be radically plucked by decadent literature, it is towards her, that celestial beauty, that have flown the first confidences of simple hearts that know how to love. Venus received their incenses, and gave them in exchange the radiation of her light, which fecundates the world and eternises life.

Science has not diminished the charm of the evening star. Although mythologic fiction, born spontaneously of the very aspect of Venus, has been dispersed like a thin cloud, astronomical reality is neither less beautiful nor less interesting. We know that this bright planet is a world like our own, almost absolutely the same as regards bulk, weight, and density, and surrounded with an atmosphere higher than ours. We know that it gravitates like our floating island in the light and heat of the sun, and that its brilliancy has no other cause than this reflected light. We know, too, that our earth exhibits the same lustre, from a distance, and we have even some right to think that the inhabitants of Mars have given our planet all the qualities that we have given to Venus. We are also for them the morning and evening star—the star of confidences and mystery, and they have doubtless erected altars to us. There is one communication like another between the worlds while awaiting the true one. Is not light a celestial bridge thrown between the worlds in space? Through it they see each other, feel each other, and know each other, and space, instead of being a separation, becomes a bond between all.

The analysis of this light permits us to determine the chemical constitution of these inaccessible stars, which at the same time communicate with each other through that universal law of gravitation, by virtue of which the planets of the heavens mutually attract each other through the extent thereof, and act upon each other constantly and reciprocally.

Of all the planets of our system, Venus is assuredly the one which most resembles the earth ; and we have some apparent reason for thinking that its inhabitants may offer an organic analogy with us more complete than those of Mars, our other neighbour, and than those of Jupiter or Saturn, whatever be the epochs of their existence, seeing that the worlds are of different ages and cannot have been inhabited at the same time. Venus, in fact, has sensibly the same diameter as the earth. Instead of measuring 12,742 kilometres in diameter, Venus measures 12,729. The difference is insignificant. The area of Venus is scarcely less than that of our globe, and the same is the case with its bulk.

Our knowledge of its geography is much less advanced than that of the planet Mars, yet it is begun and several representations of it have already been attempted. The best and surest is the map that has just been made by Mr. Niesten, astronomer of the Brussels Observatory. This map is as yet merely provisional, but the observation of Venus is so difficult, the planet is so constantly covered with clouds, that it will be a long time before we shall have a more certain one.

The temperature may be higher thereon than it is in our tropical regions, if the atmosphere is not unfavourable to it. For there is here a condition that is too often forgotten, and that is that the physical and chemical constitution of the atmosphere plays a greater role than the distance from the sun in the production and distribution of temperatures. A rarified and dry atmosphere composed solely of oxygen and nitrogen, deprived of aqueous vapour would be incapable, at the surface of the globe, of preserving the heat received from the sun. Such heat would be constantly lost in space, and we should have upon the entire earth the climate of the Alpine summit crowned with eternal snows. The summits of the Jungfrau are at the same distance from the sun as the lakes and valleys of Switzerland, and yet the climate of the first is uninhabitable, while that of these enchanting landscapes is as fertile as it is delicious. It is the density of the atmosphere, and it is especially the aqueous vapour distributed in the air, that exerts the most advantageous influence. One molecule of atmospheric vapour is 16,000 times more efficacious than one molecule of dry air for storing up the solar heat. An atmosphere thus constituted acts like a hothouse—it allows the solar heat to enter, and does not allow it to make its exit.

Upon Venus, as upon the earth, it is therefore the constitution of the atmosphere that regulates the temperatures. Have we accurate data as to this atmosphere of Venus? Yes ; and even *very* accurate data.

She has revealed herself to the gaze of observers since the first studies made of her phases. The limb of her crescent or of her quadrature is not sharp or decided, but undulating and indefinite. This limb represents for the terrestrial observer the countries upon which the sun rises or sets. It is the line of the aurora and twilight. It is an evident proof of the existence of an atmosphere. It is seen at the first glance every day at this moment, and I have just again observed it.

Through spectrum analysis, we know that this atmosphere much resembles our own in its chemical composition. We recognise therein the rays of absorption of aqueous vapour, but in feeble quantity, as if the solar light reflected by Venus had not traversed a thick atmosphere, but was sent back by the upper surface of a stratum of clouds. The fact is so much the more probable in that there is constantly here an extraordinary whiteness.

The atmosphere of Venus is almost twice denser than ours. What is the action of this atmosphere upon the climates of Venus?

On the one hand, being denser and higher, and, moreover, quite rich in aqueous vapour, it must act like the hothouse mentioned above, and store up a large part of the incident solar heat. But here another factor intervenes. The effect of this heat is to evaporate the water of the seas, and the vapour produced, reaching the cold heights of the atmosphere, is condensed into clouds. The whiteness of Venus, the impossibility that all observers have experienced of distinguishing the geographic configurations of its surface with any precision, concur to confirm this view, and to convince us that an immense stratum of clouds extends constantly in these aerial heights.

This stratum of permanent clouds must render climates temperate which would otherwise appear torrid.

But here we are stopped in our description of the world of Venus through the ignorance in which we stand concerning its oceans and the distribution of its land. Geographical configuration exerts a great influence over climates. If the Atlantic Ocean did not exist, Paris would have the climate of Cracow. And then there is another problem, and it is this: What is the length of the day upon Venus?

The length of the year is known. It is 224 terrestrial days. But the duration of the revolution, which it was thought only a few years ago was fixed at 23 hours, 21 minutes, and 22 seconds, has been put in doubt by the

observations of Mr. Schiaparelli, according to which the planet constantly presents the same hemisphere to the sun. There would thus be an eternal day on one side and an eternal night on the other. On one hemisphere, light, heat, electricity, and all their consequences, and, on the other hemisphere, nocturnal darkness, cold, lethargy, and death. There would assuredly be here strange conditions of existence. But there is not as yet anything certain upon this point, and even the last observations presented by Mr. Trouvelot to the Astronomical Society of France conclude on a rotary motion analogous to that of the earth of about 24 hours.

(*To be concluded next week.*)

HOW TO PRESERVE HEALTH.

That disease is far more prevalent than our knowledge of prevention justifies can hardly be doubted. An inquiry into the cause of this evil, as well as into the manner in which it can be removed, is therefore, not inopportune.

With few exceptions, that which is done at present for the prevention of disease is limited to improving the sanitary conditions surrounding the individual, in consequence of which two very important factors are left out of consideration: Firstly, that many diseases are caused by unfavourable internal conditions, which for the most part can be traced to imperfect development and improper modes of living; and, secondly, that exposure to unfavourable external conditions is not necessarily followed by illness, for the reason that the body itself offers a certain amount of resistance to the same. Unless, therefore, our efforts be extended to the prevention of diseases arising from internal causes as well as to increasing the power of resistance, they must to a considerable extent remain inefficient.

As the means employed for the purpose of improving the surrounding conditions are well known, it will be unnecessary to enter into detail here regarding them. The deleterious substances in the outer world are principally germs and other impurities of various kinds in the atmosphere and food. That diseases arising from such causes have considerably diminished during the past few decades, owing to the attention given to isolation, disinfection, antiseptics, sewerage, cleanliness, ventilation, etc., is unquestionable.

The remaining elements in prevention, namely, the regulation of the internal conditions and the increasing of the power of resistance, are so intimately connected that they are furthered by the same measures.

Although the conditions upon which the power of resistance depends are for the most part obscure, physicians agree that, other things being equal, an individual is strongly guarded against disease when he is in good health, and that resistance diminishes when the vitality becomes lowered. Now, in order that there may be good health, *normal functional activity of all the organs* is essential. By endeavouring to secure good functional action, therefore, we do all possible for increasing resistance to disease caused by unfavourable external influences; but, in addition, we obviously aid in the prevention of functional derangements which, together with their consequences, constitute a large percentage of all diseases.

But where shall we look for guidance if we desire to learn how normal functional activity can be attained? Naturally, to the science which treats of the bodily functions, *physiology*; and we shall see in a moment that by the application of physiological principles, not only will the organs be temporarily aided in the performance of their functions, but, if continued, good physical development, that condition under which permanent health depends, will be secured. Therefore, physiology is, as well as bacteriology, to a certain extent a science of prevention, but in our eagerness to catch and exterminate germs, it has been pushed far into the background, though so much nearer home to us than the latter.

That physical development is an important element in the maintenance of health becomes obvious when we consider that, other things being equal, an organ performs its functions in proportion to its strength; hence, if all the organs be well developed, all the functions will be thoroughly performed.

But good physical development is the result of adequate nourishment of all parts of the body, and such nourishment depends upon the proper performance of all the functions. That this does not lead us into an absurdity becomes evident when we consider that imperfectly developed organs may *with assistance* perform their functions efficiently, and physiology points out how this aid can be given. *In consequence of this help*, therefore, the organs develop and perform their functions properly with ever less assistance, and the condition of perfect health is gradually approached.

Now, if we assist the organs during childhood when they are weak, not only will much be done to secure good health during this period, but the age of maturity will be reached with a well-developed body, and good health, therefore, to a considerable extent assured through life. It is true that, under ordinary circumstances, a smaller body can be nourished, with weaker organs; but if as early as the sixth year a child begins to labour from five to seven hours daily the conditions are entirely changed. During childhood a large quantity of nourishment is required for growth alone, and, if a good share of this be expended in labour, it is clear that, unless something be done to compensate for this unnatural state of affairs, when the period of growth is over the body will be imperfectly developed, with very little chance of recovering the lost ground. When this is the case, the individual will be liable to be afflicted with poor health ever afterwards; how often it now occurs is but too well known.

As to the means for assisting the organs in their labour, none is so powerful as *muscular exercise*. This agent not only plays an important part in the general nutrition of the system, having a favourable effect upon all the functions which take part in the changes through which the food must pass before being converted into tissue, namely, digestion, absorption, circulation, oxidation, and assimilation; but it likewise aids in preventing derangement of these functions—that is, a large number of diseases. The following *résumé* of the effects of exercise will show that its value has not been over estimated:—

First. Muscular contraction exerts a pressure upon the veins and lymphatics, thus pushing forward and facilitating the flow of venous blood and lymph to the heart. In this manner the excretion of the products of tissue waste is enhanced. These matters are washed out of the tissues by the blood and lymph, and after their return to the heart pass through the lungs, where the carbonic acid is given off, then through the general circulation, the remaining substances being eliminated by the skin and kidneys. When these matters, some of which are highly poisonous, collect in abnormal quantities in the system, they become more or less dangerous; even such mild symptons as headache, drowsiness, and general lassitude in those who may lead a sedentary life may probably, in many instances, be traced to their toxic effects. By muscular exercise, which hastens

the elimination of these substances, therefore, many slight ailments, which, however, are sufficient to make labour burdensome and rob life of many of its pleasures, may be avoided.

Second. The circulation is controlled mainly by the action of the heart. When the activity of this organ is increased, therefore, the general circulation will be improved. Now, the heart is stimulated to action by the presence of blood in its cavities, and muscular exercise, by hastening the flow of venous blood, will be instrumental in sending more fluid through them in a given period of time, and consequently in stimulating the organ to increased activity. As many diseases, prominent among which are those of the abdominal and pelvic organs, are the consequences of congestion, and as good circulation does much for the prevention of such congestion, muscular exercise, by improving the general circulation both by increasing the activity of the heart and aiding in the venous return, will do much to prevent a large class of diseases.

Third. The respiratory centre is increased in activity when the blood is more venous than usual—that is, when the amount of oxygen is diminished and the carbonic acid increased. Now, as an organ consumes more oxygen and gives off more carbonic acid when it is actively engaged in the performance of its functions, it follows that exercise exerts a stimulating effect upon respiration by making the blood more venous. When the activity of respiration increases, a larger quantity of oxygen enters the system; and it has been calculated that this extra supply more than compensates for that expended in exercise—a circumstance which is readily understood when we consider that during muscular action more blood passes through the lungs, thus coming in contact with more oxygen. An increased supply of oxygen enhances the oxygenation of the food, thus directly facilitating the development of energy; and, besides, oxygen being a heart stimulant, the circulation will again be favourably affected.

Fourth. Assimilation becomes furthered by muscular exercise, for the reason that more blood passes through an organ during its activity, and consequently the latter becomes enabled to absorb more nourishment and lay by a larger quantity of reserve force.

Fifth. The blood, becoming more rapidly freed of its nutrient material by increased rapidity of assimilation, will be more ready to absorb such matters from the digestive organs. Improved absorption leads to more perfect digestion, and consequently muscular exercise aids considerably in the prevention of digestive disturbances. Further, when the digestion is enhanced, more food is called for. Increased appetite, together with improved digestion, absorption, oxidation, and assimilation, naturally exerts a marked influence upon the general nutrition of the system; therefore, exercise is a powerful means to the prevention of so many diseases caused by malnutrition.

Sixth. Muscular exercise by its direct effect upon the muscular system is the means not only of developing an active as well as a strong and healthy body, but likewise of storing up a large quantity of reserve force.

But, in order that muscular exercise may result in good physical development, *it must be carried on systematically for a long period*, and especially, for reasons already given, during the years of childhood. The *nature* of the exercise plays by no means an unimportant part in its efficacy. In order that all parts of the muscular system may be brought into play, gymnastics and calisthenics are indispensable. These exercises, however, should be supplemented by outdoor sports, such as games, rowing, swimming, skating, and the like, for two reasons: Firstly, the latter contain an element of pleasure without which that exhilaration which makes exercise doubly valuable is apt to be wanting; and, secondly, the air inhaled at the time is purer than that in closed rooms, an advantage which cannot be overestimated.

In our search for means of preventing disease we have been led, as we see, beyond the province of medicine and into that of education. But the connection between these two fields, from our standpoint, extends much further, as we shall find. Though muscular exercise be carried to the point of perfection, and the surrounding conditions leave nothing to be desired, health is not assured; for, should the *expenditure of energy* be too great, there will still be marked interference with development. Hence, the *expenditure as well as the development of energy* must be considered.

Now, the energy is expended by the organs in the performance of their functions. Though ultimately derived from the food, its proximate source is, at least in great part, the tissues, which, by undergoing combustion, furnish the required energy; whether it be all derived in this way, or whether it be in part supplied immediately by the blood, is a matter which has no influence upon our problem. It is essential, however, to bear in mind that the amount of energy which can be developed in a given space of time is limited to the quantity of food digestible during this period, and, *if it be expended more rapidly than it is thus supplied, the functions are performed at the expense of the tissues.* If, therefore, we desire to guard the system against waste and allow the organs to develop properly, we must, as far as possible, *limit functional activity.* There are, however, only two functions over which we can exert a direct voluntary influence, namely, *the muscular and the mental.* But as there is ample compensation for the energy expended in muscular activity while there is none, in the physical sense, for that used in mental action, it is clear that if we desire to economise we must do so by exercising control over *mental labour.* That the energy expended by the brain during its activity is derived from the same source as that required for the performance of the other functions is, to-day, a generally accepted fact.

But, in order that it may not interfere with physical development, mental labour must be regulated both quantitatively and qualitatively.

In regard to quantity, the number of school hours must not be excessive; and introduction into school life should be gradual, so that the labour may be in proportion to the age and strength of the child. In Germany this rule is observed, the children beginning with about sixteen hours per week, to which two are added every year until the fifth or sixth, when the maximum is reached. The amount of work required at school, and in the preparation of lessons, likewise needs careful consideration.

From the qualitative standpoint the methods of instruction play an important part. When the laws of psychology are observed, the mind being treated in accordance with its nature, the channels of least resistance are used, and the greatest amount of labour performed with a given amount of energy.

As long, therefore, as physical exercise is grossly neglected, and unpsychological methods of teaching remain in general use, disease must continue in abundance, though ever so many improvements be made in sewerage, ventilation, and disinfection; for, as our argument has shown, attempts at prevention will in great part remain ineffectual until good systems of physical and natural methods of mental development have been introduced into the schools.

CANARY birds have been known to live twenty-one years.

SOCIAL SCIENCE.

MOTHERHOOD.

Much advance has been made within the last generation in the matter of the education of women: but even the ambitious programmes of the present day do not make as full or as distinct provision as might be desired for instruction in the elementary duties and responsibilities of motherhood. We are very ready to allow that not every woman is called to be a mother, and we sympathise to a considerable extent with those who object to holding up marriage as the only goal at which women should aim. At the same time we incline very strongly to the opinion that the education of no woman can be complete unless it embraces the best obtainable knowledge as to how children should be brought up and trained, and as to the qualities, physical and moral, which their proper nurture and culture demand of the mother. The woman who is not called to be a mother may be called to be an aunt, and as such may have a large share in the education of children. We are not all called upon to rescue or resuscitate drowned persons; but most of us would willingly possess the knowledge necessary for such a purpose. It may be said, Why teach the duties of motherhood more than those of fatherhood? If so, the answer is, We should teach them *more* because they are more comprehensive than those of fatherhood. and because the relation between mother and child is so much closer than between father and child. But we fully recognise the necessity for teaching the duties of fatherhood also; and, when moral culture receives due attention in our schools, the duties which a father owes to his children will not be overlooked.

Meanwhile, however, let us consider the other and more important question. Surely it would be a most suitable thing to impress upon every girl of proper age the sacredness of the maternal function. How impressively might we apply to the expectation either of fatherhood or of motherhood the words, "He that hath this hope purifieth himself." What stronger argument for purity of life could be urged than that derivable from the duty of giving sound and cleanly parentage to one's offspring? Why are so many marriages unhappy? Mainly because they are entered upon without any thought of duty or responsibility, or any sense of the restraints upon individual caprice and impulse which are essential to subsequent happiness. It would not be difficult to show in a forcible manner the actual misery which ignorance or disregard of physiological laws entails not alone on the offenders but on their progeny as well. Passing to the important question of the hygiene of the nursery, there is much that could be taught on sure grounds of science; and the subject, in the hands of a competent teacher, could hardly fail to prove most interesting. What more satisfying object can there be to a normally constituted woman than a healthy, well-conditioned, intelligent child? The result of due instruction in matters pertaining to a mother's duties would be to make the mothers of the future happier in their children and the children happier in their mothers. It is science, as we more and more see, that is chiefly required in the household. It is the lessons of experience that need to be gathered, collated, sifted, systematised, and brought home to the minds of both fathers and mothers. We constantly hear of young couples who start off with theories of their own on the subject of the treatment of children, just as if there were no established principles available for their guidance. Surely this is folly. The very last matter to which wild experimentation should be applied is the bringing up of children; and we pity most sincerely the children whose parents think that it has been left for them to originate the true principles of child-education.

That thousands of children suffer from the over-indulgence of their parents and thousands more from their over-severity, does not admit of dispute. In any course of instruction such as we have hinted at a considerable place should be given to the psychology of the child, and a considerable place also to the commoner defects of parents. It is a wise mother that does not unduly stimulate the self-consciousness of her child, and thus lay the foundation for life-long habits of affectation. If clever children do not always make clever men and women, a partial reason may be found in the way they are commonly treated. They find grown-up people constantly on the watch to hear, and most industrious in repeating, their original speeches: and soon they exchange the gift of originality which consists in seeing and expressing things in an unconventional manner, for the very inferior one of making smart speeches. They are thus forced by the very admiration of their elders into taking conventional instead of unconventional views, and speaking, as it were, to the "gallery" instead of uttering spontaneous truths. Thus—

"Shades of the prison-house begin to close
Upon the growing boy"

or girl altogether too soon. The way to promote originality is to leave the mind as long as possible in direct and living contact with things, and, to do that, it is necessary to avoid any great appearance of interest in or astonishment at the judgments the child forms or the phrases it uses. As soon as a child begins to find its own *opinions* interesting, instead of, as before, finding *things* interesting, farewell to originality! Will any one say that, if girls were taught how the minds of children might be kept fresh, they would not value the knowledge and, when the time came, try to turn it to account? We hardly think so.

Too vigorous denunciation could scarcely be bestowed upon the fashion so many mothers have of making their children mere instruments of their own vanity. Most mothers, we imagine, even in this advanced age, regard their children as gifts from Heaven; but do they suppose that Heaven gave them children that they might turn them into preposterous human dolls, and prematurely age them with the burden of social follies? Here we see the need of a strong appeal to the mother-instinct of those who are not yet mothers, that they may be led to conceive a horror of sacrificing innocent children to the Moloch of an artificial and heartless society. What do we want—manikins, puppets, little bedizened and bemannered creatures full of social spites and rivalries, or children full of healthy impulses, pure, truthful, and loving?

One point on which a judicious teacher, addressing girls on the duties of motherhood, would certainly utter a caution, would be as to allowing the mere maternal instinct to run to excess and pass beyond control. The maternal instinct must be considered as having for its object the good of the child; but, like all instincts and passions, it tends to become an object to itself, and then the interest which it is meant to subserve suffers; the child is worried and hampered by the over-abundance of maternal caresses and attentions, to the injury sometimes of its regard for the mother. We are well aware that a perfectly balanced human being is more than the most careful education can be expected to produce; but that is no reason why we should not aim at a desirable and possible balance of faculties—of reason and imagination, of thoughts and emotions, of judgments and impulses.

A woman who is all mother does not make the best kind of mother. Cases are not wanting in which an unrestrained

exeess of the maternal instinet injures the relation between husband and wife and mars the harmony of the household. All this eould be illustrated by numerous and varied examples; and this is the kind of knowledge whieh we maintain might with great advantage be imparted to the rising generation of girls. Why should human happiness be wreeked for want of knowledge which so many eould supply from their own experienee, and of seientifie prineiples whieh are the eommonplaees of all who think? The times has surely eome when motherhood should be redeemed from the automatism of blind instinet and wedded, for its own high purposes, with the foree of intelleet. We shall be happy if these few words should ineite to thought on this most important subjeet, and cause attention to be paid to it in quarters where, as yet, it has been neglected.

HELPFUL HINTS.

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

PRESERVING MILK.

J. WADE.—The bacteria in milk are destroyed, in other words milk is sterilised, by boiling. And undoubtedly the best means of preserving milk is to boil it, as is done in several establishments on the Continent, in bottles which are sealed up airtight at the boiling temperature. It should be remembered, however, that the constitution of milk is somewhat changed by the boiling process. Some of its albumen is coagulated, and other chemical changes of less importance take place, giving to the boiled milk its characteristic taste, and at the same time rendering it somewhat less easy of digestion. The addition of various antiseptic agents to natural (unboiled) milk has been advocated. The well-known preservative, "Glacialine," is understood to be composed of 18 parts of boracic acid, 9 parts borax, 9 parts sugar, and 6 parts of glycerine. Better than the use of this compound is the simple addition of 1 part of boracic acid in about 1,000 parts of milk. By this means natural milk can be preserved in good condition for a considerable length of time, and sterilised or boiled milk made more resistive to the deteriorating influence of exposure to the atmosphere. Salicylic acid is a still more powerful antiseptic; but it is objected to on account of the peculiar sweetish taste that it gives to the milk.

FIRE AND WATER.

D. S.—The reason why fire is extinguished by water is two-fold. In the first place, the heat absorbed by the water, as such, during its rise in temperature to the boiling point is considerable. Still greater is the amount of heat "rendered latent" by the conversion of water into steam. And all this heat is abstracted from the burning materials upon which the water is thrown. In the second place the water, and, of course, in a still greater degree the steam into which it is so quickly converted, permits the free access of air to the combustible materials, and without air the continuance of combustion is impossible.

MISCELLANEOUS.

G. S. WATSON.—(1) We cannot enter into any discussion of the relative merits of replies submitted to prize queries. The answers published are those which commend themselves to our own judgment. (2) Apply to Mr. George Airy, of 42, Gray's Inn-road.

H. CORYN.—Thanks for your letter, which proves that you have very carefully examined the remedies in question. We are unable, however, to give space for the discussion of results. In point of fact we believe that the inventor has succeeded perfectly in keeping his own secrets.

R. B. LLOYD.—We regret to state that we have no knowledge of any scientific explanation or confirmation of the account of a deluge given in Genesis. The most that has been accomplished in that direction is probably to be found in Mr. Gladstone's book on "The Impregnable Rock of Holy Scripture."

ENQUIRER.—Thanks for your note. (1) We regret that we cannot enter into discussions as to the consistency or inconsistency of different passages in the Bible. In our quotation the question turned simply upon the fact of suicide having been committed. (2) Mr. Hamburg, of 7, Hatton-garden, the manufacturer of the "Knight's Promenade," will be pleased to forward one to you on receipt of 3 stamps; or he will inquire into the reason why the puzzles are not on sale, as they should be, in your neighbourhood.

A. EGERTON (Cardiff).—We think you will find all your questions satisfactorily answered by Dr. Herschell in the article entitled, "A Food Fallacy Exploded," which appeared in our last issue. We shall be glad to hear from you again.

PARABOLA.—Your carefully written treatise is noticed on page 233 We regret that we can only add the MS. is at your disposal if you care to send stamps to pay return postage.

*** Owing to the great pressure on our space this week many replies to correspondents are again held over.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)

The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers

PRIZES FOR THE WEEK ENDING AUGUST 13th.

The senders of the first twelve letters, opened by us on Monday, August 15th containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, August 15th, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 15th inst. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page i. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors or the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

AWARDS.

An unparalleled number of competitors have entered for the 10s. prize this week, and the record for number of solutions has been broken. One competitor sends in no less than 80 solutions, but he has been disqualified, owing to his efforts not being accompanied by a coupon. Another competitor has therefore taken the prize with 60. The other competitors are well up in the 20's, 30's and 40's.

*** The Coupon will be found on page i.

NEWMAN & GUARDIA'S

NEW CHANGING BAG AND CARRIERS. FOR PLATES AND FILMS.

Aperfect changing-box is at last offered to the public, greatly reduced in size and weight, with new and improved mechanism, and an Index showing number of exposures. Full Descriptive Price List, post free on application.

NEWMAN AND GUARDIA, Manufacturers of Scientific Apparatus,

71, FARRINGDON ROAD, LONDON, E.C.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, ¼, 1/6; ½, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6s. 6d. 6 *months*, 3s. 4d., 3 *months*, 1s. 9d

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, AUGUST 20, 1892.

SCIENCE NEWS AND NOTES.

"Words are like nuts: we must crack their hard shells with the hammer of the understanding to get the juicy kernels of thought out of them."—ANON.

We are Still Waiting for a Good Title

and we only regret that we cannot congratulate our readers on the brilliance of those sent in. We are sorry so much labour has been wasted—for we have received over 2,500 suggestions up to date—but there is no help for it but to try again. The majority of the ideas sent to us only contain a paraphrase of our existing title, which is exactly what we do *not* require. What we do want is a name that will clearly indicate our programme—the chronicling of the march of thought, philosophy, and man. The title must, however, at the same time convey no forbidding idea of the contents of the paper, which the present one does, owing to the usually accepted definition of the word "science." The guinea prize we offer is to be earned, and a halfpenny post card can do it. The suggested title is to be written boldly on top, and the name and address of the sender in small underneath.

We Have Smitten the Electropathic Quacks

so lustily that up to date they have not even uttered one little cry. Nor do we expect them to do so. Our friends of the Zander institute have become wise in their generation and know the worth of the old maxim, "The least said the soonest mended." However, we have reason to know that like many insects Mr. C. B. Harness has only curled up and shammed death until his opponent shall have passed. But we do not intend to pass, we mean to go on smiting from time to time until the matter becomes so notorious that the proper authorities will have to step in and stop the vending of sham remedies for serious and often vital complaints. If Mr. C. B. Harness would save himself in time we would strongly urge him to retire from the shining Presidency of the Oxford-street Institute to the more humble commercial calling that he was wont to follow before he aspired to his present dangerous eminence. The rest of the staff will also do well to vanish in time, for other disclosures are coming along, and we take this opportunity to thank all those who are helping us in the good work.

Some Technical Newspapers

devote to what is fondly considered *destructive* criticism of the more catholic departments of literature a great deal of energy and ink that could be more profitably otherwise expended. An esteemed contemporary, which we will style the *Invectival Review*, since it is much given to running amuck in this manner, has proposed to itself to question our knowledge of electrical matters. Referring to our article on "Electric Belt Quacks Exposed" (page 217) there is, it seems, a failure on the part of the staff of our contemporary to see any grounds for our supposition "that an infinitesimal current must have actually passed *through* Mr. Gatehouse's leg or arm." This failure can only arise from the confusion of very badly conducting with absolutely non-conducting properties—from forgetfulness of the fact that the minutest leakage constitutes an infinitesimal current of electricity—from mistakes, in short which, while they might be excusable in an electric bell hanger, or in an average specimen of the *genus* "electrical engineer," are inexcusable in a journal devoted professedly to theoretical science. Out of regard for the reputation of our friendly contemporary, we would seriously caution it against committing itself to *original* statements; and particularly against repeating such, after the errors therein have been pointed out by SCIENCE SIFTINGS. Probably this little piece of advice will be accepted.

Is Hard Work Necessarily Overwork?

We think not; and our opinion is borne out by Dr. Pye Smith, who is of opinion that, in treating the question whether laborious occupations in themselves may lead to premature strain of the body or mind, and so to degeneration or disease, we "must distinguish." Many abnormal conditions of the system may be the result of overstrained and too violent and prolonged exertion, from mechanical stretching of the great arteries by movements of the arms, from high-blood pressure, excessive calls on the heart, and over-long suspension of respiration. We see similar results in horses which are put to too hard work at too early an age, and there is no reason to doubt the operation of such causes of disease in man. But their operation is limited to the production of certain definite lesions, and there is no evidence that harm is done, disease brought on, or life shortened by what is commonly known as work, whether mental, physical, or a combination of the two.

The Vanity of Human Nature

is tickled by ascribing its disorders to such respectable antecedents as industry, energy, and intellectual activity. We must all have felt this, says Dr. Pye Smith, when the results of habitual idleness or gluttony are ascribed by a patient or his wife to an over-taxed brain or too strenuous devotion to business—especially in the public service. "There is no fear of any one of us" (Members of the Royal College of Physicians) he is reported to have humorously added, "using our brains too much for our health, nor do I believe that mental labour or honest work of any kind interferes with health or shortens life a day. Even if it did, who would not rather be worn in use than rust in idleness?" Who would not choose a short-spanned life, filled full of action and of thought, of sorrow and of joy,

of effort and of endurance, of enjoyment of living one's self and helpful service to others, rather than to wear out a tedious existence of monotonous ease?

Excessive Eating

is, however, the abuse that tends to the injury of brain-workers more than any other cause. Many active brain-workers have suddenly broken down, and fancied that it was due to brain fatigue, when, as a matter of fact, it was due to over-stuffing of their stomachs. The furnace connected with mental machinery became clogged up with ashes and carbon in various shapes and forms, and, as a result, disease came, and before the cases were fully appreciated, a demoralised condition of the nervous systems was manifested, and they laid the flattering unction to their souls that they had indulged in mental overwork. Hard work, mental or physical, rarely ever kills.

If a Mild Amount of Physical Exercise be Taken,

and a judicious amount of food be furnished, the bowels kept open in the proper manner, the surface protected with proper clothing, and the individual cultivates a philosophical nature and absolutely resolves to permit nothing to annoy or fret him, the chances are that he can do an almost unlimited amount of work for an indefinite length of time, bearing in mind always that, when weariness comes, he must rest, and not take stimulants and work upon false capital. The tired, worn-out slave should not be scourged to additional labour. Under such stimulus, the slave may do the task, but he soon becomes crippled and unfit for the work. The secret of successful work lies in the direction of selecting good, nutritious, digestible food, taken in proper quantities, the adopting of regular methods of work, the rule of resting when pronounced fatigue presents itself, determining absolutely not to permit friction, worry, or fretting to enter into his life. and the cultivation of the graces, charity, patience, and philosophy.

An Inordinate Amount of Exercise

or exercise taken under unwholesome conditions may neutralise all the good effected by the wisest of dietaries. See the anxious, wearied face of the cyclist, for instance. Here is a healthy sport nullified by being "overdone," and usually indulged in on insufficient food, or even worse, on a full stomach, when digestion naturally demands rest. Speaking of a recent great record, the *Lancet* says that the cost to the rider was altogether unwarrantable, for during the twenty-four hours in which a rider was occupied in covering 400 miles his heart knew no rest from full activity, and the elastic coat of every artery in his body was in full tension. In some instances such is the tension that the man literally propels himself in what may be called blindness. His legs work automatically and his course is directed in a manner very little different. When a bicyclist was unfortunately killed from an accident caused by fast riding, a witness said, on oath, that the rider was going so fast and was so intent on the race he did not hear witness until it was too late, that is to say, until he got within two yards of a cart into which he ran, when he altered his whole position, called out "Oh!" In another instance, where one of the long and sleepless rides was carried out, the rider was seized with vomiting, which never ceased during the whole of the effort. He, too, lost the guiding power of his senses, and for some miles tugged on as if he were blind, tearing away, in fact, in a kind of trance, his higher nervous centres paralysed and his body retaining its life and mere animal power, held living by the respiratory centre and the heart, they also being taxed to the very extremity of danger.

The Risk Implied in such Exertion,

even when there is escape from immediate accident, is dangerous up to the verge of insanity. We do not deny that every now and then a young man in the bloom of health and full of vital energy, is able, during his short physical prime, to complete these remarkable feats and stand out for the moment the model of physical power in this one direction of it. Watching him in the plenitude of his strength, his companions will jeer at us, and will ask us to tell them whether we can detect in him any demonstrable change for the worse. We are prepared to say "perhaps no," for we have not yet at our command the knowledge and means for detecting the first and minor indications of organic injury from physical strain. We admit, further, in all fairness, that a man may one or more times pass through the strain and not be so much injured as to be left bearing, necessarily, a life so shortened that the period of the shortening will admit of correct measurement. But, says the *Lancet*, we must claim to hold that, although we may be unable to determine the infliction of injury by our present refined methods of diagnosis, we have the best and most common-sense reasons, derived from experience.

Assuming that the Body at any Age

and in the finest condition cannot be exposed to the strains to which we refer without being oppressed beyond the bounds of safety; whilst we are absolutely certain that the oppression often repeated is of necessity a serious cause of organic degeneration. On this last head experience of the clearest kind is our guide and monitor. We have watched the fate of those who, in the brief period of the history of these violent exercises of strength, have excelled and have run through their short day and generation, and we regret to record that no experience is more painful or more instructive for purposes of warning. Man is not an engine of iron and steel, but an organism of flesh and bone and blood that has to be renewed from day to day and from hour to hour, and his energy is not roughly chemical but vital in its nature; he is constructed for other and nobler purposes than mere engine labour: and if he throws himself into mere engine work he will soon become an engine so disabled that his better self will fall into death before he has reached what in others better trained would be the prime period of vital strength and activity.

Mars is in Brilliant Form

just now, and will be even more so. The two factions—those who contend that the planet is in an advanced state of refrigeration, and those who state that it is in a most habitable, if not inhabited condition—may shortly have some sound data to work upon. The spectrum analysis has led, however, to the inevitable conclusion that the atmosphere on Mars differs from ours only in density and chemical composition, but that life under somewhat changed conditions from that on the earth is possible and altogether probable. Following out the theories that Mars is fast approaching its end, come the observations made in 1877 and 1881. The doubling of the so-called "canals" led to the belief that its atmosphere was rapidly becoming vapourless, and that the sudden cooling of the planet would lead to most violent eruptions. Many an astronomer will look for conditions like those on our moon, extinct craters and other evidences of a dead world, during this present period of best observation. Most interesting observations were made of Mars in 1877 at Milan, Italy, and there also the discoveries this year promise to be important.

Many Interesting Observations

were made by the late Richard Proctor. He found a cloud-bearing atmosphere on Mars, and seemed satisfied that the dark spots on Mars were seas and the light-ochrist coloured regions continents. "A traveller," said he, "can visit almost every quarter of that planet without leaving water, and with land always in sight and almost always on both sides." He believed that a trip of 30,000 miles would enable a traveller to reach every portion of land on the planet. Mars has ever been the planet of observation. Venus, when near the earth, is between the sun and this world, and always shows us her dark side, making observations exceedingly difficult. Mercury is also "blinded" by sunlight at times when a sight would be opportune, and Jupiter and Saturn are ever surrounded by a mist which is well-nigh impenetrable. So we have always considered Mars, bloody-named and ruddy-looking as he is, the best point for observation of planetary affairs.

Kepler's Great Discovery

of the law of planetary movement was made by observations of Mars. When the great astronomer was compelled to abandon the circle and circular motion as a means of representing the planetary revolutions, he adopted the ellipse as the probable form of the orbits of these revolving worlds, and made an especial effort to apply this new figure to a solution of the mysteries which still enveloped the motions of Mars. Many were the hypotheses which he framed, computed, applied, and rejected. Finally fixing the sun in the focus of the assumed elliptic orbit, and assuming that the line drawn from the sun's centre to the planet would sweep over equal amounts of area in equal times, he computed the places of Mars through an entire revolution. These newly-computed places were now compared with those actually filled by the revolving world, and Kepler found to his infinite delight that the planet swept over the precise track which his hypothesis had enabled him to predict, and with an exultation of victory to which the history of pure thought furnishes few parallel. Kepler announced to the world his first two laws of planetary motion, which are given as follows: "(1) Every planet revolves in an elliptical orbit about the sun, which occupies the focus. (2) The velocity of the planet on every point of its orbit is such that the line drawn from the sun to the planet will sweep over equal areas in equal times."

The Flying Machine,

the construction of which by Mr. Maxim was described in the first issue of SCIENCE SIFTINGS, has, we understand, been abandoned, the capitalists who were backing the enterprise having grown tired of the expense, and at the fact that no flying has yet been done. This is all very regrettable. Nevertheless, all efforts to perfect a flying machine are not, of course, at an end, and intelligent perseverance often accomplishes wonders. It seems more than probable that if aerial flight is ever accomplished it will be done at a greater expenditure of power than would be required to transport the same loads at the same speeds by present means, but there would be, of course, great advantages in flight, which, for many purposes, would overbalance considerations of economy. It is quite certain that any device that requires a considerable expenditure of power merely to maintain its altitude or distance from the earth, must be at a great disadvantage as compared with present means of transportation, in which no power is required for this except that incidentally expended in overcoming friction introduced by the wheels and axles which maintain this altitude.

The Camera is the Weapon of Warfare

that unruly mobs of the future will have to fear. For the first time, we believe, in the history of photography has the snap-shottist replaced the sharp-shooter in repressing rebellion. It is a sign that "man's inhumanity to man" is on the decrease, and we rejoice at it. During the fearful riots at Mr. Carnegie's works at Homestead, a correspondent on the spot writes us that cameras were used on the battlefield by the agents of the company who were measquerading as workmen. On the films in these cameras were imprinted the portraits of men who were seen in the act of shooting at the unfortunate men penned in the rat-hole of a barge from which there was no hope of escape. These pictures have been developed, and the copies are now in the hands of men who needed this evidence to warrant arrests, and they will be made. How many it is impossible to say. There may be a dozen, there may be more. One thing is certain, very few guilty men will escape, thanks to the first merciful weapon of warfare ever invented.

A Silent Gun

has been invented by Prof. Garner to aid him in his researches into the mysteries of the Simian speech. He thinks he may often desire to secure a certain animal from among a herd without frightening the others, which an ordinary firearm would, of course, do. It is a silent gun. The barrel consists of a straight reed, bored and smooth. The ammunition for the gun is a missile, which is driven by the force imparted by two rubber bands and two steel springs. This missile, which is made of steel, is shaped like an arrow-head, is hollow, and is to be filled with 15 drops of prussic acid. It is so contrived that upon its entering its quarry it will be forced open, and the contents discharged in the animal struck, producing instant and painless death. Another contrivance—a masked battery, it might be termed—consists of a canteen, to which is attached a hose about 2 ft. long, on the end of which is a metallic nozzle, provided with a ring to fit the forefinger, and a valve opening and closing. The canteen will be worn buckled under the arm, while the nozzle will be worn on the fourth finger of the right hand, so that it may be used instantly in case of surprise. This will be charged with concentrated ammonia, a douche of which will stifle the most ferocious beasts.

Chloride of Nitrogen

is the most wonderful as well as the most powerful explosive known. For 77 years, from 1811 to 1888, the secret of the composition of this terrible explosive was a mystery. Dulong, who lost one eye and three fingers in the year 1812 in a vain effort to determine its component parts, was the first man of scientific attainments to give the stuff thought and study. Later on, Faraday and Sir Humphry Davy devoted a great deal of time and attention to it. Before entering the laboratory both Davy and Faraday always provided themselves with thick glass masks to protect their eyes from flying pieces of glass, which were most sure to start on a tour of the room whenever a drop of the dangerous stuff was exposed. Faraday once narrowly escaped death as a result of making an experiment with two drops of the yellow, oily agent of death, which he had dropped into a small silver thimble prior to making an experiment, and at another time had his table ruined and the glass mask on his face broken into bits by less than one grain of it. In 1888, as above hinted, Dr. Gattermann of Gottingen, Germany, succeeded in analysing the mysterious compound. It is the only known substance that will instantly explode on coming in contact with a bright beam of light, whether the beam be from an electric lamp or the sun.

GLEANINGS OF THE GLOBE.

Chloral was discovered by Liebig in 1831.

Lampblack was invented by Mini in 1844.

Quicksilver was first used in the arts in 1540.

The streets of London, if put end to end, would reach from here to St. Petersburg.

Careful scientific investigations show that the average speed of the transmission of earthquake shocks is nearly 16,000 feet per second.

The lighthouse tower at Cape Hatteras is 189 feet high from its base to the centre of the lantern. It is the tallest lighthouse tower in existence.

A dish of charcoal placed in your meat larder will keep the articles as sweet and wholesome almost as well as ice. Charcoal is a great disinfectant.

It is probable that Cornelius Drebbel, a Hollander, in the year 1630 first discovered a method for indicating changes of temperature by means of a glass bulb.

Scientific experiments have shown that during profound sleep a noise not sufficient to awaken the sleeper produces a perceptible rise in the brain and head temperature.

The longest tunnel in the world will be that now to be commenced through the Simplon. According to the final plans adopted it will have a length of 12·6 miles, or 3·1 miles more than the St. Gothard tunnel.

There is a church in the town of Bergen, Norway, that is built entirely of paper. It can seat 1,000 persons in comfort, and has been rendered waterproof by a solution of quicklime, curdled milk, and white of egg.

According to M. Flammarion, the French astronomer, the mean temperature of Paris during the past six years has been about 2° below the normal. It is also stated that Great Britain, Belgium, Spain, Italy, Austria, and Germany have also been growing cold.

In a recently invented watch for the blind, a small peg is set in the middle of each figure. When the hour hand reaches a given hour, the peg for that hour drops. The owner, when he wants to know the time, finds which peg is down and then counts back to XII.

As far as can be calculated, the average length of life, which is computed in the seventeenth century to have been only thirteen years, was in the eighteenth increased to twenty, and in the nineteenth to thirty-six. Men used to be considered old when they passed fifty.

As an instance of the sudden destruction of animal life, it is interesting to note that, on the occasion of some heavy rains in Texas recently, so much sediment was carried to the rivers and streams that the water became so thick as to kill the fish, which floated by thousands down the flood.

For more than 2,000 years, a dressed stone containing 12,922 cubic feet—being 71 by 13 feet in size—has rested on pillars in a quarry at Baalbac, in Syria. It was intended for the foundations of the temple of the sun, a mile or more distant, to which four stones nearly as large were actually transported.

Another instance of the reasoning power of animals: When an Egyptian dog wishes to drink at the Nile, he goes a short distance up the river and howls for some time. The crocodiles being attracted by the sound, immediately crowd to the place, while the dog hastily runs to the part which the crocodiles have left and drinks in safety.

The Home Office is considering the advisability of letting electricity supersede oil in the policeman's lantern. The light is strong and brilliant, and there is no difficulty in lighting it, as there is in the case of oil in wet or windy weather. The lanterns proposed give a continuous light for 7 hours. The proposed lamp only weighs 4 ounces.

The great American electricity stealing case has now been decided. Not, however, to everyone's satisfaction, for the culprit was discharged. The judge would not concede that the offence was petty larceny and the grand jury would not allow that it was fraud, so when the case came up a plea for formal acquittal was entered, which was concurred in, and the defendent was discharged. Will wire-tapping to secure free illumination now be legalised in America after this precedent?

Mr. T. H. Morgan, writing from Switzerland as to theories of sun spot influence upon terrestrial temperature, etc., says that while we must all admit that any such investigations as would elucidate these assertions, would be a gain to science, "they must be undertaken scientifically, not assertively, by men of patience, and the determination to deal with a vast amount of material, and with the ample knowledge at command to estimate aright, which way the balance of proof tends."

Never does a mushroom season come round but one meets with cases of so-called poisoning. The best treatment is suggested by Mr. S. Grose, of Melksham, Wilts, and seems to consist in the consumption of copious draughts of warm water, which provoke easy vomiting; and, then, what does one see? Almost invariably that true mushrooms have been swallowed in chunks unbitten. And this is a case of "poisoning!" Let those of us who delight in the delicious esculent fungi attend to the detail of well biting before swallowing and we run small risk of being poisoned by mushrooms.

Many American drinking saloons, have dice boxes to encourage their patrons in "throwing for the drinks." Science has come to the aid of these delightful specimens of humanity, who cannot throw half quickly enough by the hand, and the dice thrower can now gamble his fortune away, if need be, by the mere pressure of his fingers. Many places of public resort are being supplied with the electrical dice box which has five small cupolas of glass, under each of which is seen a single dice. Five buttons are arranged in front, and when these are pressed, the dice are rapidly revolved, and instantly fall into their new position.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 42.

175.—What is the cause of the change of taste and colour in food after cooking; and why is cooked food more wholesome?

The changes of colour due to the cooking of food are the result of chemical modifications of structure, brought about by the action of heat. But the nature of the colouring matters concerned in these changes is often very complicated, and they belong to a class of organic compounds which have not yet been strictly investigated by chemists. If the composition of these various colouring matters, which from their nature could be readily isolated, is as yet but imperfectly known, still less have the flavours of cooked and uncooked foods been subjected to the scrutiny of chemical analyses. Indeed, the hitherto unsolved question, what peculiarities of physical structure give rise to the sensation of taste must necessarily be answered before the great differences in taste-exciting power between many very closely allied substances can be explained. It may be stated generally, however, as to food that is cooked and served hot, that all substances when in a slightly heated condition stimulate the organ of taste more energetically. The second part of the question can be definitely answered with respect to a great number of articles of food. Starch is present to the extent of 82 per cent. in arrowroot, 79 in rice, 66 in wheat, and 55 per cent. in peas. It is, in short, a principle constituent of breadstuffs and many vegetable foods. Cooking is, in all these cases, a very great aid to digestion. The reason—the bursting of starch granules under the action of heat and moisture—is too well known to need much explanation. The nutritive juices which are expressed by cooking meat are not necessarily lost, and as the shrinking and separation of the fibres which takes place under the action of heat renders mastication easier, cooking is distinctly of advantage in this case also. Albuminous foods are more or less coagulated by cooking. Here it cannot be said that digestion is facilitated, but, of course, the desirability from another point of view of raising all food to the boiling temperature, at which any bacterial organisms that may be present are destroyed, shortly before eating it, must not be overlooked.

176.—Why can some fish live in salt water, but not in fresh, and vice versa?

In attempting to draw a line of distinction between fresh and salt water fishes we meet with a great number of species and of facts which would seem to render such a distinction very vague. There are not only species which can gradually accommodate themselves to a sojourn in either salt or fresh water, but there are also some that seem to be quite indifferent to a rapid change from one into the other. Individuals of the same species may be found some distance out at sea, while others live in rivers far beyond the influence of the tide. And almost every large river offers instances of truly marine fishes ascending for hundreds of miles of its course, while, on the other hand, fishes belonging to the fresh water genera descend and sojourn in the sea for a more or less limited period. These migrations of fresh water fishes have indeed been compared with those of birds. It must be admitted that a very few fresh water fishes, such as the grayling, seem to be so sensitive to changes in the composition of the fluid in which they live as to perish when transplanted from their native river into another apparently offering the same physical conditions. It can only be surmised in such cases that what is one fish's meat is another fish's poison. And if one desires to be more precise, it may be suggested that the disturbing influence relates to the presence or absence in the water of certain bacterial organisms. Speaking generally, however, the distinctions between fishes in different situations are simply the result of adapations of habit and organisation to local circumstances, among which perhaps the chemical composition of the water is almost of the least importance. Among the causes by which natural selection and the survival of the fittest are determined, may be mentioned the temperature, motion, and pressure of the water, and the amount of light transmitted through it, all of which vary enormously at different depths; also the kind of food that is obtainable and the enemies that have to be encountered. An inconvenience that would result from an unaccustomed change of density (and, therefore, of refractive index) in the water is that the fish whose eyes were not possessed of considerable accommodation would be unable to see without spectacles. He would be unable to pursue or to escape pursuit, perhaps even unable to distinguish food, and he would quickly succumb to this disability alone.

177.—What is the source and process of manufacture of iron?

The ores of iron are chiefly oxides, such as hæmatite and magnetite, and carbonates (clay ironstone and siderite). Freedom from sulphur and phosphorus, which are very injurious to the quality of iron, and are difficult to get rid of, is one of the most valuable features of an iron ore. The ore, with certain proportions of pure coke and limestone, is placed in a "blast furnace," where it encounters an ascending current of hot air. Very interesting chemical reactions take place here, which are minutely described in Sir J. L. Bell's treatise upon the subject. Virtually, the carbon of the coke passes away in a gaseous condition in combination with the oxygen of the iron ore; while the heat generated is sufficient, with the aid of the limestone "flux" that is present, to reduce the earthy matters of the ore to liquid slag. "Cast iron," as it runs out from the bottom of this furnace, contains a considerable proportion of carbon, with other impurities. These are in great part burned out by remelting the iron in a "puddling furnace." The process of manufacture is finished by working the iron, while intensely hot, in rolls or other machinery. Thus the texture of the iron is made uniform, and the inclosed slag, owing to its greater mobility, is driven out from it, as water may be from a sponge.

178.—How is unbreakable glass made?

What is called toughened glass is only to be distinguished from ordinary glass by the physical arrangement of its particles. It has been annealed by first heating in an oven, and then immersing it in boiling oil, which is only allowed to cool very slowly. When at last it has become cool, the "toughened" glass may be considered to be in a state corresponding to some extent with that of steel when it has been annealed and softened.

179.—What is the difference between a quicksand and ordinary sand, and are there any unfathomable quicksands?

The only essential difference between a quicksand and ordinary sand is that the former having been subjected to a process of elutriation must consist almost exclusively of the smallest sized particles. Quicksands are often found in tidal pools that occur in basins lined with impermeable clay. They also take rise in narrow channels of porous sand, that are banked by more impervious material. A current of water traversing such a channel suffices to keep even the larger sand particles stirred up. The suction reputed to be exerted by quicksand is a myth. Persons sink into it exactly as in common water, only more slowly. It is said that if the victim did not struggle he would not sink overhead, as experiments have shown that water containing a quantity of solid matter in suspension has its floating power increased. The situation would not, however, be an attractive one. As for bottomless quicksand, that is a mere figure of speech, and certainly a very misleading one.

180.—What is the scientific explanation of the changed condition of water when it is boiling?

Water evaporates at all ordinary temperatures. But at the boiling point the rate of evaporation is very greatly increased. This is due to the energy with which the particles of water are agitated at this temperature being greater than that of the particles of the superincumbent air. The balance of pressure that previously existed at the surface of the water is at this point overcome; and the vapourised particles, no longer waiting to be, as it were, dissolved in the air, push this away bodily, and so remove the only obstacle to rapid evaporation. When the pressure of the atmosphere is removed mechanically, by the use of an air pump, it is found, in confirmation of this view, that water boils briskly at the ordinary temperature of 60° F.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

187.—What causes spontaneous combustion to take place in coal or cotton, etc.?

188.—What causes the singing noise made when a kettle is nearly boiling?

189.—Why do colours fade when exposed to sunlight?

190.—Why is fruit more wholesome in the morning than in the evening?

191.—How is copper prepared from its ores?

192.—What is the difference between static and galvanic electricity?

SIMPLE CAUSES EFFECT BIG RESULTS.

Curious and interesting is the fact that the playing of children on the slopes of Flamsteed-hill, on which the observatory of Greenwich stands, sets the hill into vibration to such an extent as to interrupt observations which depend upon the motionlessness of a tray of mercury. Hundreds of children are accustomed in the evening to romp upon the hill outside the observatory walls. Joining hands they run headlong down the slope, and tumble in a heap at its foot. The result is that the solid hill is thrown into such a state of tremor, that the vibrations continue to be felt at the observatory until long past midnight, and for many hours after the tired children have been asleep.

ETNA'S ERUPTIONS.

Mount Etna, the eruption of which threatens to assume formidable proportions, is located in the north-east portion of the Island of Sicily, adjacent to the sea and near the City of Catania. It is an isolated mountain of conical form, and is separated from the other mountains of Sicily by the Valley of the River Alcantara. It is 10,935 feet in height, and has a circumference, at its base, of 90 miles. Its volcanic phenomena are presented on a greater scale than those of any other European volcano, and attracted greater attention from the ancients.

Thucydides mentioned an eruption which occurred in 425 B.C. Four violent eruptions are recorded as having occurred in 20 years, viz., 140, 135, 126, and 121 B.C. In ancient as in modern times the volcanic action of Mount Etna was irregular and intermittent. On various occasions the City of Catania has been nearly ruined by the eruptions of the volcano and the accompanying earthquakes. Several of the ancient writers describe the upper part of the mountain as covered with perpetual snow, but, at present, snow lies there only during eight or nine months of the year.

Eighty-one eruptions are recorded since Etna has had a history, the earliest in the time of Pythagoras, the most recent in 1874; of these, not more than 19 have been of extreme violence, while a majority have been of a slight and a comparatively harmless character. The recent eruptions were in the years 1868, 1874, 1879, 1883, and 1886, that of 1868 being the last to be classed among the exceptional disturbances.

The eruption of 1886 commenced on May 18, and continued until the first week in June. There were premonitory symptoms in the form of earthquakes and a fall of hot cinders, which were thrown as far as Messina, some 80 miles distant. A lava stream was seen to be issuing from a crater in the side of Monte Penitello, about a mile south of the English house where the Government Observatory is situated. "Twenty-four hours afterwards," wrote an eye-witness to the *Daily News*, "streams of lava were seen coming out at seven other points, and a day later these seven new volcanoes all joined the principal crater, so that red-hot lava was poured down simultaneously in a volume nearly two miles in breadth. The rate of descent was reckoned at an average of 20 yards an hour.

"From time to time great massive stones were cast down, together with a deluge of hot water." As this stream continued to advance for days, and rolled nearer and nearer to Nicolosi—the town situated at the foot of the mountain—the greatest alarm was excited amongst the inhabitants, who implored heaven to avert the impending disaster. Thus the veil of St. Agatha, the patron saint of the district, who is said to have miraculously intervened in the eruption which threatened Catania in 1669, was borne through the streets of Nicolosi with great ecclesiastical pomp, while the people brought out the images of the saints from the churches to the Piazza, and there prayed for the desolating flood to be arrested.

The stream was described by another eye-witness, who ascended the mountain and looked down upon the crater, as a sea of bright red angry lava, "not liquid, as most people suppose, but consisting of many millions of large and small blocks of rocky-looking stuff rolling onward." The eruption, however, slackened early in June, and finally ceased on the 5th, after engulfing a convent and many woods and vineyards, at a point only a few hundred yards of the nearest house in Nicolosi. For some days after, however, earthquakes of considerable violence continued to be felt

throughout the Etna region, causing much terror, and in one place they destroyed several houses.

The volcano's majestic height is less imposing to the imagination than its vast extent, for "Il Monte" has an area of 462 square miles. Two cities, Catania and Aci Reale, and 62 small towns cluster upon the slopes of the awful mountain, whose entrails are fire, and whose breath is flame and lightning. Catania has a population of nearly 100,000, and Aci Reale of about 23,000.

Nine miles beneath the crater, which is about 1,000 feet in depth, three miles in width (it was rent anew into great fissures by the last eruption), the habitable zone commences, and is tenanted by 300,000 souls. Only the Val del Bove, commencing two miles from the summit, where Sir Charles Lyell believes there formerly existed a centre of permanent eruption, is altogether sterile now: the other sides of the mountain are clothed with trees at the same level. And such trees! Fourteen separate forests form the Regione Selvosa, and they abound with the oak, beech, pine, and poplar, with the chestnut, the ilex, and the cork tree. Mariposa and Calaveras cannot beat the "Castagna di Cento Cavalli," in the forest of Carpinetto, on the east side of the mountain, in whose trunk, through which the public road now passes, a Queen of Aragon once took shelter, with a suite of 100 horsemen. The Regione Coltivata, whose soil consists of decomposed lava, is lavishly fruitful; of the three regions, of which the Deserta has the most powerful charm for the imagination, Brydone says:—

"Besides the corn, the wine, the oil, the silk, the spice, and delicious fruits of its lower region: the beautiful forests, the flecks, the game, the tar, the cork, the honey of its second; the snow and ice of its third—it affords from its caverns a variety of minerals and other productions, cinnabar, mercury, sulphur, alum, nitre, and vitriol, so that this wonderful mountain, at the same time, produces every necessary and every luxury of life."

The story of the ascent of the mountain from whose summit Plato, in his serene and thoughtful time, and Mr. Gladstone, in our troublous days, have, among many great men, in great wonder, watched the sunrise, has a strong fascination, because of its wide contrast, its stern exaction of strength and endurance, and its supreme, awe-inspiring reward—the realisation of that which inspired the ancients and the poets of the Middle Ages. From the banana and the orange groves, from the vineyards and the palms, through the seven botanical regions into which the botanists have divided the realm protected of Persephone—because "amid the billowy cornfields of her mother, Demeter, and the meadow-flowers she loved in girlhood, are ever found sulphurous ravines and chasms breathing vapour from the pit of Hades"—to the snow-capped crust that spreads for 10 square miles between the awful depth of unquenchable fire and the blue heaven that suddenly seems to be brought near, the traveller mounts, with an ever-increasing sense of the vastness beyond and around him.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

If you have an idea for a patent, write to the Editor of SCIENCE SIFTINGS, giving the outline of your scheme. The communications will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

PSYCHOLOGICAL TRAINING.

A few—only a few—years ago we learned psychology from antiquated text-books that by tales of extraordinary occurrences, quotations of poetry, emphatic assertations, occasional proofs by the phrase "it is evident," and a few improperly observed facts, gave a complete exposition of the human mind in 500 or 600 pages—except in some cases where the author was kind enough to be satisfied with half that amount. To day a psychologist of that kind lectures to bare benches in the universities of Germany, and the new psychology has got such a hold that it is rapidly becoming a fashion, if not a fad.

Still, in this very fact there lies a great danger to the proper development of the science. There is a tendency to careless work, to rapid shuffling off of quasi-experimental researches, to a neglect of the drudgery of a scientific investigation of the fundamental problems, and to a pursuit of ghost stories, telepathy, and sensational hypnotic tales. Even where the psychologist is really a scientific man there is a tendency to rest contented with merely qualitative results where quantitative measurements could be made with the exercise of brains and patience.

In regard to the sensationalism and quackery that have assumed the garb of psychology we can do no more than every other science does in that respect,—simply put the public on its guard. If, as is usually the case, the public prefers swindle to science, the matter is beyond our control. There is also little to be said against the so-called "theoretical" or "metaphysical" psychology that has blocked scientific development in the past and opposes it in the present. The "metaphysical" psychology is neither metaphysical nor psychological; the term is used merely to cover up the inability or the dislike for careful observation and experiment, it being much easier to sit at home in the study chair and spin out a work on psychology than to put on the apron, clean batteries and smoke chronograph drums in the laboratory.

What is to be called to attention here is the fact that we psychologists, says one of the body, are not making the proper efforts toward exactitude in our experiments. In the first place it is becoming too common to consider that going through any careless series of manipulations is making an experiment. An experiment is the systematic variation of the conditions governing a phenomenon in order to observe the results of such a variation. The amount of systematic preparation required and of careful observation to be exercised depends on the stage of development in which the science finds itself. Any lack of preparation that could have been expected, or any deficiency in the necessary care, removes the pretended experiment from the realms of science to that of dilletantism. Dilletantism may be all very good as a source of amusement, but it must never be considered as science. As Wundt has remarked, "the most dangerous enemy of psychology to-day is not the metaphysical psychology of former days, but the self-sufficient amateurism that considers every aimless toying as a scientific experiment."

Aside from this amateurism there is another deficiency, perhaps of a still more important nature. In the various periodicals we meet accounts of qualitative experiments that might just as well have been made quantitative. Of course qualitative experiments are necessary as preliminary investigations, but they are inexcusable where quantitative ones can be made. That is to say, although they are necessary as

forerunners of measurements, and although at certain stages of investigation, they are of incalculable value, yet the scientist must never rest satisfied with them, but should regard them only as stepping-stones for further progress. We can find no better way of stating this than by repeating the words of Sir William Thomson: "I often say when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be."

The first step in an investigation is a determination of the relations of dependence between various phenomena; this however, must give place as soon as possible to a measurement of the changes in the mutually related phenomena. This we can already do to a great extent in regard to mental processes. The degree of accuracy obtainable is in some cases scarcely second to that of physical determinations, but in others it falls far below.

The future of psychology, however, lies in the possibility of increasing the accuracy of the measurements of mental phenomena. An advance in accuracy is a difficult thing; but it is of such importance that any sacrifice of time and trouble is justifiable for that purpose. To reduce the error of observations in a given problem by a tenth is a great task, and it becomes greater with each increase in accuracy. Psychology, however, is in the fortunate position of being in possession of methods more accurate than the majority of psychologists are able to apply. Wundt and his followers have gone ahead so rapidly that on the one hand their results can claim an accuracy only one degree less than that of physics, but on the other the psychologists who have never had a training in his laboratory are not quite able to keep up the pace. This, of course, does not apply to those domains of mind not yet subject to measurement.

It is very true that there are still large groups of mental phenomena not yet investigated by experiment; we have not yet found a measure for hate, for enthusiasm, or for vertigo. There are still others in regard to which we stand at present just on the point of introducing experimental methods without having achieved anything of great importance; such are the subjects of pleasure, hallucination, the lower senses, etc. Yet again we find those that are fast yielding themselves up to qualitative and even quantitative analyses, *e.g.*, volition in some of its results, the sense of equilibrium, pain (dermal pain quantitatively measured), smell (quantitative measurements by Zwaardemaker and Henry), etc. On the other hand the magnificent achievements in the domain of sight, the good ones in hearing, those in the senses of pressure and temperature, the accurate measurements of visual space, the measurements of the reaction-time, etc., have all tended to place experimental psychology on a high level and to furnish a foundation for a science of psychical measurements, or psychometry.

What is the reason, then, that we are doing second-rate work when we might do first? The trouble lies, it seems, in the lack of a proper training. We attempt to make experiments; but how many of us have received a practical training in the use of our apparatus? We make observations; but how many are familiar with the methods of observation and the computation of errors? We obtain tables of results; but how many know how to formulate the equation expressing those results? "I know," say one who has studied the question, "that, until I was brought face to face with the question of what to do with my figures when I had got them, it had not occurred to me to remedy my deficient training by a study of the methods of expressing results." We all of us daily use light, sound, heat, electricity, etc., in our experiments; but how many are familiar with the units and the methods of measuring these forms of energy? What a psychologist must have is a thorough course of training in psychometry, or the methods of psychical measurement.

"Summing up, I would say that what we need in experimental psychology is: no quackery, little amateurism a proper estimation of qualitative work as subordinate, a transformation of the qualitative into quantitative investigations, and as the means of obtaining all this, a thorough laboratory training."

ABOUT WATCHES.

Formerly watches were much prized, and the greatest of care was bestowed upon them. Since they became cheap, however, they have been mercilessly subjected to every kind of destructive influence. Dust, sudden variations of temperature, falls, and magnetism are only a few of the ills that they encounter. And then people are astonished that they do not go properly. In comparison with any other machine, a watch is a marvel. Some figures will enable us to demonstrate this fact. The main spring moves the barrel, its motion being transmitted by three wheels to the escapement, the teeth of which fall on the pallet or cylinder of the balance, at the rate, on an average, of 8,000 blows per hour (with differences of 3,000 to 4,000, according to the construction); while another gearing retards in the proportion of 12 to 1, the motion given to the hour hand.

All the movements of a watch are interrupted, and are carried out by little equal jumps, the number of which exceeds 200 millions per annum in some watches. Those who are anxious to keep their watches in good order have them cleaned every two years, that is to say, after 300 to 400 millions of motions. After 20 years, a watch well made, and not prematurely injured, must have several pinions changed; but it is after several millions of these little leaps of which we have just spoken, and after the escapement wheel has made tens of millions of revolutions. If we add to this complications like the chronograph, date indicators, minute repeaters, etc., we are astounded at their possibility.

As for the path described by the exterior of the balance-wheel, it is so great that all our readers may not be convinced until they have made the calculation for themselves. The balance of a watch measures, on an average, 17 millimetres in diameter; it makes 5 oscillations per second of one revolution and a half, or 395 millimetres of run per second, 34 kilometres per day, 12,500 kilometres per year, in round figures. Watches with a perpetual date indicator have a wheel which makes one revolution in four years; during this time the balance would have travelled as far as round the world. The small power involved in the going of a watch is no less remarkable. According to the *Journal Suisse d'Horlogerie*, a watch spring weighing 2 grammes gives a motion of 40 hours duration. At the accepted rate of 20 kilogrammetres of available power per kilogramme of the steel spring, we have 40 gramme-metres for 40 hours, or one grammemetre per hour. One horse-power develops in one hour $75 \times 3{,}600 = 270{,}000$ kilogrammetres; a watch requires, therefore,

$$\frac{\cdot 001}{270{,}000} = \frac{1}{270{,}000{,}000} \text{ horse-power.}$$

In other words, 1 horse-power would suffice for the motion of 270,000,000 watches, or, probably, all the watches in the world. It is the escapement which utilises most of this power; the escapement wheel is rapidly set in motion, and undergoes a sudden stoppage, which always causes a loss of *vis viva*, or, as we should now style it, a degradation of energy. The air's resistance to the movement of the balance-wheel, and the coiling and uncoiling of the spiral spring also cause losses of power. What, then, remains for the gear and pinions? Very little.

THE SHEPHERD'S STAR.

By Camille Flammarion.

One unexplained phenomenon is perhaps connected with the long exposure of the globe of Venus to the solar light, and that is the visibility of its non-illuminated disc in the interior of the crescent. Everyone has been able to remark, at the epoch of the new moon, during the first days of the crescent, that the body of the moon not lighted by the sun is visible in the interior of the crescent, pale, greyish, scarcely marked. This is what is called the ashen light. The part of the moon non-illuminated by the sun is then lighted by the earth, which reflects into space a light fourteen times more intense than that of the full moon. This ashen light of the moon is thus the reflection of a reflection, perfectly explained.

But no known cause explains the same aspect often observed upon Venus. Could it be a fluorescence or a *phosphorescence* of its clouds or its seas?

The astronomer Gruithuisen dared to attribute this brightness to illuminations made by the inhabitants of Venus, on days of political and religious fetes.

Fontenelle somewhere speaks of a world deprived of moon, and in which the rocks composed of phosphorus store up the solar light and send it forth during the night in thousands of varied hues. I believe even that he adds thereto glow-worms and moths flying like sparks of fire in the warm and almost hot atmosphere (I do not dare say electrified, for the ingenious author knew nothing about electricity). Bernardin de Saint-Pierre represents to us the landscapes of Venus ornamented with tropical plants bearing magnificent fruit and inhabited by humming birds of brilliant plumage, turtle doves, and lovers. Tranquil lakes reflect the azure of the sky, and beings ravishing in form and agility dispute with each other there, in swimming, for prizes that Pleasure will crown.

We cannot yet affirm that the abode of Venus is absolutely delicious, that there do not exist there summers too hot nor winters too cold, nor physical or moral miseries, nor even perfidies great or small, masculine or feminine. But we may think that nature has been able to provide this habitation, whatever it be, with organised beings for accomplishing their destiny thereon, and it is perhaps not difficult to imagine that these unknown brothers are a little more intelligent—a little more *intellectual* especially—than their neighbours of the earth. They ought not to resemble us. We have an innate tendency to seek in the unknown life for a resemblance, an analogy with ours. We are vaguely penetrated with the idea that the planetary humanities must have been formed upon the type of our species, and it seems to us that no beings can have existed without having been organised in our image. We would not only have them breathe as we do, eat and drink after our manner, and act, walk, or sleep, but we also pretend to figure them in the same form and do not conceive of beings which may be neither men nor women, or may not have legs, lungs, or stomach, or which, instead of five senses, may have ten or fifteen, among which ours may not be included. Still, as the human form is the result of the organic forces in activity on the surface of our planet, there is no reason that the inhabitants of the other worlds should resemble ours.

We have no plausible reason for imagining that the inhabitants of the other worlds of space are made in our image either as to form or organic substance. The substance of the terrestrial human body is due to the elements of our planet, notably to carbon. The terrestrial human form is derived from ancestral animal forms from which it has gradually risen through the continued transformation of beings. It doubtless appears well to us that in order to be a man or woman, it is necessary to have a head, a heart, lungs, two legs, two arms, etc. We are constituted as we are solely because the prosimians had also a head, a heart, lungs, legs, and arms, less elegant than yours, madam, undoubtedly, but of the same anatomy. By degrees we easily ascend to-day, through paleontology to the origin of beings. It is just as certain that the bird is derived from the reptile by a progress of organic evolution as it is that the human kind of the earth represents the summit of the immense geological tree of which all the branches are brothers and whose roots penetrate the very rudiments of the most elementary primitive organisms.

All the forms imaginable and unimaginable must people the multitude of the worlds. The terrestrial man is endowed with five senses, or more properly six. Why should nature have stopped here? Why, for example, should it not have endowed certain beings with an electric sense, with a magnetic sense, with a directing sense, with an organ perceiving the ethereal vibrations of the infra-red or of the ultra-violet, permitting of hearing at a distance, or of seeing through walls? We eat and we digest like coarse animals. Do not worlds exist in which the nutritive atmosphere allows the inhabitants to dispense with so ridiculous a labour? The smallest sparrow and the sombre bat have the advantage over us of flying in the air. Is not ours a very inferior world, where a man of the greatest genius or the most exquisite woman find themselves tied down to the earth like vulgar caterpillars before metamorphosis? Would it be so disagreeable to inhabit a world in which we might enjoy the privilege of flying whither we chose; a world of perfumes and pleasures where the flowers are animate; a world upon which the winds are incapable of fomenting a tempest; where several suns of different colours (the diamond associated with the ruby or the garnet with the emerald and the sapphire) radiate night and day, blue at night and scarlet by day, in the glory of an eternal spring, many coloured moons slumbering over the mirror of the waters, phosphorescent mountains, ærial inhabitants, men and women, or perhaps other sexes perfect in their form, as incombustible as asbestos, endowed with a multiple sensibility, luminous at will, perhaps immortal?

Liliputian atoms that we are, let us then once for all be well convinced that all our imagination is only a barrenness in the midst of the infinite, scarcely caught sight of by the telescope. And on these beautiful evenings while Venus is shining with all her brilliancy, in face of the sublime spectacle of the starry night, when we think of the unknown worlds that fill space, let us be assured that they are inhabited, have been or will be, their vital cycle not being necessarily contemporaneous with ours, and that an infinite

diversity reigns in the fields of the heavens as in the gardens of the earth. There are the humanities, a great number of which must be incomparably more advanced than ours upon the route of perfection.

Our earth, with all its political, social, and religious history, is only a poor and small ant hill, is only the flight of a dragon fly of one day in a ray of the sun.

(Concluded from last week.)

A WONDER IN FIGURES.

Multiply 987654321 with 3 or a multiple of 3, the result will be 3 times 3 certain figures—if multiplier 9 or a multiple—nine alike figures and the multiplier 3, 6, 9, 30, 60, 90, as last figure. Is the multiplier two figures, 12, 15, 18, and so on, or three or four figures, 102, 105, 1002, and so on, the first figure of the multiplier, respectively the first two or three will be in front and the last figure of the multiplier at the rear end of the 3 times 3 certain or nine alike figures. This rule is good up to 171, which is irregular, also 180, and hereafter once every twelfth and twice every ninth number; that is, 192, 201, 210, 222, 231, 240, and so on. With three figures irregular multiplier, the second figure in front will be one less and the second from the rear end one more; with four figures irregular multiplier, the third or the second and third figures in front will be so much less than second or second and third figures from rear end are more, to bring out the 3 times 3 certain or nine alike figures in the middle. The following list will show:—

Multiply 987654321 by

3.....	296 296 296 3
6.....	592 592 592 6
9.....	888 888 888 9
12.....1	185 185 185 2
15.....1	481 481 481 5
18.....1	777 777 777 8
21.....2	074 074 074 1
24.....2	370 370 370 4
27.....2	666 666 666 7
30.....	296 296 296 30
33.....3	259 259 259 3
36.....3	555 555 555 6
39.....3	851 851 851 9
42.....4	148 148 148 2
45.....4	444 444 444 5
48.....4	740 740 740 8
51.....5	037 037 037 1
54.....5	333 333 333 4
57.....5	629 629 629 7
60.....	592 592 592 60
630	6 222 222 222 30

All added.

72.....	7 111 111 111 2
81.....	8 000 000 000 1
99.....	9 777 777 777 9
102.....10	074 074 074 2
132.....13	037 037 037 2
156.....15	407 407 407 6
186.....18	370 370 370 6
207.....20	444 444 444 7
246.....24	296 296 296 6
438.....43	259 259 259 8
648.....64	000 000 000 8

And so on.

Observe with 9 it is all 8s, with 18 or twice 9 all 7s, with 27 or three times 9 all 6s, and so on.

Irregular 3-figure numbers—take one from the second last and add to the second in front.

987654321 x 171 =	16 888 888 8891	x 270 =	26 666 666 6670
180 =	17 777 777 7780	282 =	27 851 851 8522
192 =	18 962 962 9632	291 =	28 740 740 7411
201 =	19 851 851 8521	300 =	29 629 629 6300

Irregular 4-figure numbers—take off second or second and third last and add to third or second and third front.

987654321 x 2457 = 242 666 666 6697 — take 3 from second last and add to third front.

3582 = 349 773 773 7822 — take 9 from second and third last and add to third and second front.

4368 = 431 407 407 4128 — take 5 from second and third last and add to third and second front.

5247 = 518 222 222 2297 — take 6 from second last and and add to third front.

5256 = 519 111 111 1176 — take 6 from second and third last and add to third and second front.

Multiply 123456789 with 3 or a multiple of 3, the result will be again 3 times 3 certain figures, and with 9 as multiplier 9 alike figures, but the multiplier is to be added to the multiplicand. This rule is good up to 81. With 84 and upward, the result being eleven figures, the first figure is to be cut off and to be added to the second last figures along with the multiplier, as follows:—

Multiply 123456789 by—

3 =	370 370 367 —add multiplier, 3
6 =	740 740 740 —add multiplier, 6
9 =	111 111 1101—add multiplier, 9
12 =	148 148 1468
15 =	185 185 1835
18 =	222 222 2202
21 =	259 259 2569
24 =	296 296 2936
27 =	333 333 3303
45 =	555 555 5505
81 =	999 999 9909
84 =	1 037 037 0276
99 =	1 222 222 2111
102 =	1 259 259 2478
273 =	3 370 370 3397
324 =	3 999 999 9636
2457 =	30 333 333 0573
	2457
	30
	3330

Add 84 and the first figure to second last:

0276
84
1
0370

Multiply 123456789 x 8 = 987654312
Multiply 987654321 x 8 = 79012345 68

both pretty near a reverse of one to the other.

Divide 987654321 x 8 = 123456790 4—

also a remarkable showing. Finally:—

Multiply 987654321 x 1 =	987654321
2 =	1975308642
3 =	2962962963
4 =	3950617284
5 =	4938271605
6 =	5925925926
7 =	6913580247
8 =	79012345 61
9 =	8888888889
and added up.....	44444444445
Multiply 987654321 x 9 =	8888888889
twice 9 or 18 =	17777777778
3 times 9 or 27 =	26666666667
4 times 9 or 36 =	35555555556
5 times 9 or 45 =	44444444445
6 times 9 or 54 =	53333333334
7 times 9 or 63 =	62222222223
8 times 9 or 72 =	71111111112
9 times 9 or 81 =	80000000001
	400000000005

Remarkable, looking at the columns—the first running from 1 to 8 down, the others from 8 down to 0, and the last from 9 down to 1.

OBSERVATIONS on live rattlesnakes, show that the poison glands become functionally active as soon as the snakes begin to shift for themselves, which must be very soon after birth. Experiments on the young ones six days after birth proved the presence of venom in small quantities. Experiments made three months after birth showed that considerable venom is secreted, as a pigeon, inoculated at this time, died in two hours with the usual symptoms of chronic poisoning.

HOW OLD IS THE EARTH?

How old is the earth? has been the ever-recurring question which the multitude has been putting to the geologist, and which that man of science, with all his pretence of contempt for the mere vain curiosity of the common herd, has ever been trying recklessly to answer. When the world—that is to say, the penny newspaper world—first began to interest itself in the speculations of the philosophers, it was startled to learn that the traditional 6,000 years which we had all been taught to look upon as the age of our worthy planet was an exploded notion altogether. Scientists told us, with a grim pleasure in the torture they were inflicting, that our earth must have existed many thousands of millions of years; and the evidence they adduced was terrific in its weight. We were gradually adapting our historic consciences to this most depressing view of things when, a few years ago, Sir William Thomson came to our rescue with the hopeful news that the earth could not have been in existence for more than 400 millions of years, and that it was scientifically conceivable that its age might not exceed the trifle of 20 millions of years.

The margin was wide enough to allow of further investigation before geology could claim to be an exact science, but there seemed to be some satisfaction in getting any authoritative definition of the limits within which speculation might roam, and Sir William Thomson got a peerage—*post hoc*, if not *propter hoc*. The theory he expounded was based on calculations of the heat which the planet could bear when it first came into shape from chaos, and of the possible rate at which the heat had been dissipated. He finally fixed on the convenient figure of 100 millions of years as about the period which might be reckoned to embrace the whole geological history of the globe. Following Lord Kelvin's theories, and improving upon them, Professor Tait has lopped off 90 of these millions, and suggests 10 millions of years as a more reasonable hypothesis of the time within which the processes of earth-cooling could have occurred.

Thus we were galloping back gloriously to our old figure of 6,000 years, but now the geological authorities have put their backs against the wall, and claim once more to be heard. Sir Archibald Geikie, LL.D., D.Sc., Foreign Secretary of the Royal Society, F.R.S.E., F.G.S., and Director-General of the Geological Survey of the United Kingdom, has, says the *Chemist and Druggist*, the ear of the world, and from the tribune of the British Association, over which he presides this year, he answers back those frivolous physicists. Without claiming, to use his own expressive phrase, "the whole of bygone eternity," for the mutations and developments which the crust of the earth affords, he "can hardly doubt that there must be some flaw in the physical argument," though he does not pretend to be able to say where it is to be found. "Some assumption, it seems to me, has been made, or some consideration has been left out of sight, which will eventually be seen to vitiate the conclusions, and which when duly taken into account will allow time enough for any reasonable interpretation of the geological record."

In view of the sweeping reductions of time which the physicists demand, the President of the British Association plaintively compares the geologists' position with that of King Lear when his bodyguard of 100 knights was cut down. "What need you—five-and-twenty, ten, or five?" demands the inexorable physicist, as he remorselessly strikes slice after slice from his allowance of geological time. Sir Archibald Geikie is inclined to admit that the demands of the early geologists for an unlimited series of ages were extravagant, and even for their own purposes unnecessary, and he believes in occasional sudden convulsions and upheavals, and natural catastrophes. But there are processes of denudation and deposition clearly traceable, and capable of actual measurement. The speed varies according to circumstances, but, taking the sediment moved by rivers to the ocean as an example, he says:—

"In some cases the lowering of the surface of the land may be as much as $\frac{1}{730}$ of a foot in a year; in others it falls as low as $\frac{1}{6800}$. In other words, the rate of deposition of new sedimentary formations, over an area of sea-floor equivalent to that which has yielded the sediment, may vary from 1 ft. in 730 years to 1 ft. in 6,800 years. If now we take these results and apply them as measures of the length of time required for the deposition of the various sedimentary masses that form the outer part of the earth's crust, we obtain some indication of the duration of geological history. On a reasonable computation, these stratified masses, where most fully developed, attain a united thickness of not less than 100,000 feet. If they were all laid down at the most rapid recorded rate of denudation, they would require a period of 73,000,000 of years for their completion. If they were laid down at the slowest rate, they would demand a period of not less than 680,000,000."

HOW TO TEST THE EYES.

Impairment of vision is almost as common as all other forms of diseases of the human body put together: and much of it is due to exhausted nervous energy and debility in general. The causes, however, are generally overlooked, and all manners of remedies, including eyeglasses, are resorted to to correct the evil without avail. The only recourse seems to be to wear strong glasses and keep increasing the strength as time goes on, while all the time the vision keeps getting worse with ultimate blindness staring the patient in the face.

To prove whether or not the eye is structurally impaired punch a pin-hole through a piece of card-board or thick paper of any kind, the cover of a SCIENCE SIFTINGS, for instance, and place the aperture close to the eye. If it be sound the smallest print can be distinctly read through the pin-hole. If unable to read through the aperture it is proof of an organic disarrangement of the eye, especially of the retina, which makes it necessary for that organ to have skilled attention. On the other hand, if the vision is distinct and enables the common wearer of very strong glasses to read fine print through the pin-hole, he had better, as a rule, give his eyes a rest from special remedies, and turn his attention to building up his general physical condition.

As that progresses the eyes will keep pace, and when the man in general is completely restored to health the eyes will also be found healthy. The exhaustion of the nervous forces, dyspepsia, chronic liver complaint, and chronic constipation, all have a bad effect on the eye. These are purely common-sense suggestions, without any encroachment upon the medical profession.

VOLUME I. OF "SCIENCE SIFTINGS"

IS NOW READY.

Bound in Cloth and Gold, 3s. 6d.; Postage 6d. extra.

Or from Messrs. W. H. Smith & Son,

and through any Newsagent.

PROTOPLASM AND THE POTATO.

As some perhaps look upon the potato, it appears to be a very admirable source of food for man, but it is hardly biological to attribute to the plant such exalted altruistic motives of disinterested generosity as it might imply if we should intimate that this is the end and aim of its existence. There is a class of mankind who appear to deem it proper, like Pope, to hold all nature to account for itself as useful to man, and such would doubtless say that the potato was created to be a food product. To the biologist's ways of thinking, this end of the potato's life is merely incidental—from its standpoint a very unhappy incident; the real end and aim of the potato's life is to propagate its kind, the storage of starch being a part of the plan.

The life of the tuber of the potato is part of the larger life of the entire plant. The history of the tuber, as ably described by Mr. H. L. Osborn, is as follows: It starts from a bud on a preceding "seed potato," of which and of whose predecessors it may be thought to form a part, but really it is (like cuttings or slips from any plant) the beginning of what we may call a new plant. The early growth of the cells in the embryonic part of the bud requires food, to furnish which is the reason for the starch supply. But after a time the growing bud tissue differentiates into stem and leaves and rootlets, and then it can begin to depend, as all green plants do, upon the sunlight and the water and gases of the air and soil, and with their help construct their own substance. The starch of the potato tuber thus acquires a biological meaning. Its production and storage are perfectly analogous to the provision made in the seeds. In the case of the peanut, we have also an underground structure stored abundantly with food for the undeveloped embryonic tissue, which is also part of the nut. The substance in many seeds is largely albuminous, as shown so abundantly in the pea and bean, also in the peanut, which is a close ally of the pea and bean.

Since the potato tuber and the pea or bean are thus comparable in two respects, both being the starting point of new individual plants and both containing cells which secrete and amass large quantities of food to nourish the embryo plant until its vegetative organs are developed, a hasty conclusion might be made by some that the potato is a sort of seed. This conclusion would be found by the study of the anatomy of the entire plant to be true only in a very particular sense, and not as meant in ordinary terms. The seed is the product of a ripened flower, while the tuber is not. There is a very great difference in the powers of potato seed and of the tuber bud; the latter propagates its kind absolutely and without variation, while propagation from seeds is very likely to result in the appearance of varieties unlike the parent plant. We have in this case an example of the law that nature works very variously toward the same end, using the stem bud in one case as the special organ of propagation and the seed in another, equipping either suitably for its purpose.

Finally, if we compare the potato with an animal, we find that the aggregate of its actions are anabolia, that is, they are constructive, so that as their result elements, or simple inorganic compounds, are laid hold upon and caused to combine to form higher and more complex organic compounds used in the plant's structure. In this it is unlike an animal, the aggregate of whose activities is katabolic, for it takes in highly complex chemicals (furnished from the plant's work) and gives out simpler ones. Associated with the difference is the further fact that the functions of motility and sensation, which are so characteristic of animals and are possible by reason of the constant katabolic character of its metabolisms, are unspecialised in the plant if not entirely absent, while the metabolic function is highly specialised and results in the production of anabolic products in the vast amount we see in the tuber.

We see then that the same forces are at work in the vegetable as in the animal body. The active agents of the tuber are protoplasmic cells, which work along lines determined by inheritance, and manifest certain of the protoplasmic powers in so high a degree as to nearly exclude the others, but retaining the two most universal powers of protoplasm—metabolism and reproduction.

WHAT IT TAKES TO MAKE HONEY.

"Did you ever consider how many flowers are required to supply 1 pound of honey?" said a naturalist. "About 2,500,000 is a fair estimate. Think what a vast amount of toil by hard-working bees that represents! However, there are other creatures besides bees that gather honey. For instance, there is the 'honey-wasp' of tropical America, and the honey-making ant of Texas, and New Mexico. The latter is very abundant in the neighbourhood of Santa Fe, and the sweets it collects are highly esteemed by the Mexicans not only as food, but for medicinal purposes. There is an insect called the 'tazma' in Ethiopia which deposits its stores of honey without wax. It looks like a giant mosquito, and its product, which it hides away in holes under ground, is eagerly sought by the natives as a remedy for diseases of the throat.

"There are giant bees in India which suspend combs as big as house doors from the branches of trees in the forests. In the Koono province of Lithuania bees are reared in excavated tree trunks in the woods, and the famous Koono honey derives its peculiar and delicious flavour from the blossoms of the linden trees which are so abundant in that region. One tribe of people in the province devotes its attention exclusively to bee-keeping. Bee-keeping is taught in Switzerland by paid lecturers, who go from town to town and from canton to canton. In that country honey is a staple article of food even among the poorest classes, bread and honey being the most common breakfast. One gets nothing else for the morning meal at the big hotels. Consequently nearly all of the Swiss product is required for home consumption, and very little of it is imported.

"All over Continental Europe apiculture is a very important industry. The German Government compels all schoolmasters to pass an examination in bee-keeping. European Russia produces 700,000 pounds of honey annually. The ancient Greeks were famous for honey-making, but the business is neglected by their modern descendants. Corsican honey is rendered so bitter by the arbutus blossoms from which so much of it is obtained as to be unpalatable. The greatest bee-keepers in the world are in the United States. Single individuals in California each own from 2,000 to 12,000 swarms, which they farm out to the owners of orangeries and other fruit orchards during the blossoming season. One bee farm in San Diego County in that State furnishes 150,000 pounds of honey annually. Some bee farmers have floating bee houses, which follow the streams to find flowering pastures for the insects. This was done in Egypt thousands of years ago. It has even been proposed to send swarms by ship to the West Indies in winter."

SOCIAL SCIENCE.

WHAT EDUCATION DOES NOT DO!

It is not the purpose so much of higher education to fill the mind with knowledge as it is to discipline and develop the mind, and it is not so much the object of the college to make professional men as it is to prepare the student for a professional career.

An inquiry into the psychical constituton of normal beings will show some marked general characteristics. For example, some possess great executive powers associated with marked powers of application and execution; others possess great reflective powers associated with slight powers of execution and little or no executive ability; and others again may possess all these powers equally strong, or they may be variously combined in individuals as to degree and quality. The intention is not to enumerate any more characteristics than such general ones as come into use in business. All these powers admit only of a certain degree of development.

It is conceded that every normal being is endowed with certain natural abilities to acquire knowledge. The degree of the development of these abilities and the direction in which they run are often difficult to determine; and here it is where the largest number and most serious mistakes are made. Every individual, no matter what his abilities are, must receive a certain amount of training and education, and these may come to him in one form or another, either practical, theoretical, or both. The acquisition of knowledge through personal experience alone will prove both good and bad, and it is through a theoretical training and education that the bad may be avoided. In discriminating between all the degrees of natural abilities supplemented with practical training and natural abilities supplemented with book learning, an important element will be found which can only be acquired through systematic book training and proper schooling, and that is discipline. Discipline gives discriminating powers and quickness to the perception, lends accuracy to the conception, aids the reason to draw proper conclusions from a series of facts, and thereby sharpens the judgment, develops the memory, controls the will, and subjects the emotions. In connection with this, the attention may be called to the fact that a methodical mind is not always a well disciplined mind.

Again, there is a distinguishing element common only to natural ability, and which does not depend upon knowledge alone or any higher psychical organisation called knack. This is generally noticeable in powers of execution. For example, if we observe a number of mechanics working at the same job, it will appear that a few of them show exceptional facility in the execution of their work, while others with all their training and practice cannot attain this facility. The degree of difference in the work may not be great, yet it is noticeable; and the man who is the happy possessor of this particular gift is the man most sought for.

A comparison of various individuals within the different classes in which men may be classified from the standpoint of vocation will show similar results. As an illustration we need only to take two orators. Suppose them as nearly as possible to be equally equipped mentally, morally, and physically, yet when addressing an assembly there will be seen a marked difference in the effect produced upon the audience. To the one they will listen with indifference; to the other they will appear as if they drank in every word that fell from his lips. So again, if two orators unequal in education and training address an audience, it is not infrequent that the one possessed of the lesser education and training will hold his audience spell-bound, while the other will leave his audience cold and unaffected. The question will now arise, To what can this difference be attributed? The solution undoubtedly lies in the peculiar, fascinating influence exercised over the listeners through the method, the style. It is this which inspires truthfulness, conviction, and confidence, and may be considered a quality of executive ability. In every vocation of life we may trace this quality as essential to success. The author, the poet, the lawyer, the actor, the politician, the merchant—all of whatever class will profit by possessing this quality. True, this quality may be developed to a limited extent, yet the possessor of it by nature need have hardly any schooling or training, and he will succeed.

The questions, which will now present themselves for consideration, are, Why is it that so many men of very inferior mental capacity and in some instances of marked natural ability, though uneducated, are so successful in accumulating large fortunes, and why is it that so few college-bred men are successful in the commercial world and become possessors of large fortunes?

It is not infrequent where men equally equipped mentally, either educated or uneducated, start out in the world both having the same habits of thrift and economy, of industry and energy, of perseverance and endurance, and both having equally good opportunities for making money, that one of them succeeds in accumulating a large fortune, while the other gets along but moderately. The statement is quite generally admitted that a person who is economical, prompt, reliable, honest, and accommodates himself to the circumstances, and does not meet with any misfortune, may acquire sufficient means to live fairly well, but to acquire a large fortune something more is requisite.

To what this difference may be ascribed is the question. Surely, it cannot be maintained that one has more brains than the other or that he possesses better advantage by whatever means, for the assumption is that they are equal in these respects. Then the only factor to which this can be attributed is unquestionably the style or peculiar influence they exercise over others, and by which they inspire confidence and enlarge their circle of patrons. As an argument in favour of this view a reference to cases where men are totally unworthy of confidence needs only to be made. How often does it happen that men morally perverted are capable of inspiring confidence in people, and this not only in the unwary and ignorant but in men of brains and education. How often do men of inferior intellect exercise much influence among the educated and ignorant. To attribute this to any other power than the peculiar fascinating influence that many men have over others is absurd. The average business man, however great his success may be, and who has received no college training, is narrow, emotional, exacting, and will often resort to means in accomplishing his purposes which a college educated man would hesitate to do, and most college-bred men of this stamp will possess these traits inherently.

That the school of experience quickens self-reliance, that it gives positiveness to one's opinions and conduct, that one more readily forms his final conclusions from first impressions, and that a well disciplined mind might avert many sad experiences, which an undisciplined mind is obliged to go through, is undisputed. That the college graduate has many edges to round off when he enters upon the struggle for existence is manifest. During his entire college course he has only heard of the highest standards of the intellect and

of morality. Although he has been taught to deal with things as they are, yet a large portion of his instruction has been devoted to things as they should be; and therefore when he starts in life he must adjust himself to life as it is. Whether this is a fault in that the training is not held within the limits of the practical may be an open question. But, on the other hand, that a college education has the tendency to make one more humane, to broaden one's views of life, to make one more liberal, to quicken one's perception, to lend accuracy to the judgment, and insure more logical thinking, cannot be denied.

Our Monthly Edition.

SCIENCE SIFTINGS may now be obtained in Monthly Parts, bound in buff wrappers. Price 6d., or post free, 8d., of any Newsagent; W. H. SMITH & SON'S bookstalls; or of the Publisher, 78, Fleet-street, E.C.

HELPFUL HINTS.

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

POWER OF MAGNIFYING GLASS.

W. A. S.—The power of a magnifier depends, not on the diameter of the lens, but upon the curve to which it is optically worked, *i.e.*, the focal length. Nor is it independent of the visual peculiarities of the individual using the glass. A good rule for rough purposes is to divide 5 by the focal length of the lens in inches. The quotient is the linear magnifying power. Thus a lens of 1-inch focus magnifies 5 diameters; one of $\frac{1}{10}$-inch focus magnifies 50 diameters. Send name and address (not necessarily for publication) with your next inquiry.

SUN SPOT SCIENCE.

E. KENNEDY.—Thanks for your letter. We always read your communications with interest, and admire the ingenuity with which natural phenomena are by you rendered subservient to the illustration or explanation of your remarkable theories. On the other hand speculations such as these are of a particularly controversial nature. We have already received a number of letters, some of them from well-known meteorologists, expressing dissent from your views, and even as to some of the facts cited. Feeling compelled to close the discussion in our columns, at least for the present, we would recommend you to communicate a paper on the subject to the Royal Meteorological Society. Your suggestions must be considered, as Mr. Morgan says, in connection with a vast compilation of data. And having already given publicity to the broad outline of your views, we must decline to proceed further with the task in these columns. The address of the R. M. Soc. is Great George-street, Westminster.

MISCELLANEOUS.

T. H. MORGAN.—Many thanks for your interesting letter, which is referred to on p. 242. See also reply to E. Kennedy above.

W. S. HARPER.—Thanks for your suggestion. We will keep your name before us.

Replies to S. Sheal, H. S. Rogers, "Mercury," W. H. Neal, H. Nye, G. T. Oliver, R. W. Green, Jun., "Reader," and others are unavoidably crowded out.

TENBY.—You cannot do better than write to Mr. O. E. Horn, Newport, I.W., who will give you advice free.

S. COURON, JUN.—We have seen the experiment with the silver coin and circle of copper wire, described in our issue of 2nd ult., successfully tried. But, perhaps, some caterpillars are more sensitive than others to electricity. We recommend you to connect up the pieces of metal to a small galvanic battery. This should be effective with the most adventurous caterpillars.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)
The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers

PRIZES FOR THE WEEK ENDING AUGUST 20th.

The senders of the first twelve letters, opened by us on Monday, August 22nd containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, August 22nd, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 22nd inst. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page i. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors or the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

AWARDS.

A competitor has carried off the 10s. prize this week with 90 correct solutions; the other 10s. has gone to a competitor who sends in 78 solutions. The 2s. 6d. prizes have been awarded in the usual manner.

*** The Coupon will be found on page i.

All Prescriptions are carefully prepared at Store Prices.

HEPPELL & Co.,

(From SWANN, PARIS.)

Pharmaceutical & Foreign Chemists

35, HAYMARKET,

PICCADILLY CIRCUS, LONDON, S.W.

SPECIALITÉ:

"POUDRE BAINS ADOUCISSANTE."

THE PHOTOGRAPHIC "TABLOIDS,"

(B., W. & CO.)

Portable, Accurate, Energetic, and Lasting.

These "Tabloids" are most convenient for preparing Solutions. Prices: Pyro Accelerator, bottles of 25 and 70, at 6d. & 1s. each. Quinol-developer, in bottles of 25 and 70, at 6d. & 1s. each. Pyro Accelerator, Bottles of 30 and 100, at 4d. & 9d. each.

BURROUGHS, WELCOME & CO., Manufacturing Chemists, SNOW HILL BUILDINGS, LONDON, E.C.

Edwards' Isochromatic Plates AND Films

Give Truthful Portraits without Retouching.

With them every Amateur can take pleasing Portraits, as well as Landscapes and Snap-Shots.

"Instantaneous" for Portraits and Hand-Camera Work. "Medium" for Landscapes and Copying.

PRICES, $\frac{1}{4}$, 1/6; $\frac{1}{2}$, 3/8; 1-1, 6/6 PER DOZEN Complete List on Application.

B. J. EDWARDS & CO., THE GROVE, HACKNEY, LONDON.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*, 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, AUGUST 27, 1892.

SCIENCE NEWS AND NOTES.

"Credulity has been well defined to be 'belief without reason,' and scepticism its opposite, 'reason without belief.' It is difficult to determine which is the more incompatible with practical common sense."

Our New Title

still remains in abeyance, although we can now congratulate our readers on having sent us one or two possible suggestions. We shall, however, accept none of these for a week or so, but invite others who have not yet attempted it to make an effort to carry off the guinea prize that we offer for any title we may adopt. What we desire our new name to comprehend is thus set forth in a kindly little paragraph in the *Birmingham Daily Gazette*. Says our contemporary: "That excellent little magazine called SCIENCE SIFTINGS is looking about for 'an alluring title of a general nature that will embrace everything of interest to mankind,' and invites the ingenious assistance of its readers. The object is to avoid the appearance of dulness, as some people think everything scientific is necessarily dull. The magazine is anything but that; but by any other name it will be just as interesting. It has a good name, that is to say, a good reputation now; if a change of name be a double-barrelled improvement, so much the better."

Much Food Actually Digested

and assimilated is not used to the fullest extent for want of sufficient oxidation to make it yield the greatest amount of vitalising power to the tissues of the body. Such partially unoxidised products have an irritating effect on the organs and tissues, and predisposes them to disease if they do not directly affect them with it. Exercise has a stimulating effect on all parts of the body by inducing further oxidation in all the tissues and organs. This increased oxidation is attended by a greater demand on the part of the system for oxygen—as indicated by the greater number, force, and frequency of the respirations.

During Exercise the Heart Beats Faster,

and forces more blood through the lungs to all parts of the body, bearing in its little blood cells the precious life-giving factor, oxygen. These little cells—one constituent of which, hœmoglobin, has the wonderful faculty of quickly loading and unloading itself with oxygen—thus act as direct aids to the process of oxidation in the tissues and organs. It is the combining of oxygen with unoxidised products in the blood that gives to each individual cell its possibility of sustaining life. Any process which increases the oxygen supplied to all parts of the body tends to strengthen the life in each individual cell, and to give it more power to resist disease. Exercise of all factors does this most effectively, and besides actually producing in each individual cell a greater vitality, it gives a favourable opportunity for the waste products of the tissues to be thrown off rapidly. By thus causing a further oxidising of certain matters in the blood, it conduces in a double sense to life and health. Habitual outdoor exercise, with suitable protection from extremes of weather, is the most effective means of prolonging life to old age.

The Hygiene of the Teeth

as we have explained in various articles, has nothing whatsoever to do with the consumption of a particular form of diet, but with cleanliness. An authority in the *Lancet* points out that all caries of the teeth begins from the outside, no such thing as internal caries having ever been demonstrated; hence if the surfaces could be kept absolutely clean no decay could take place, however poor the texture of the teeth. This is, of course, impossible, but much towards such a desirable end can be attained by attention to hygienic rules. Parents often ask their dentists and medical attendants with reference to their babies: "When ought teeth to be cleaned?" The answer assuredly is: "As soon as there are teeth." A very small toothbrush charged with some precipitated chalk flavoured with an aromatic drug to make it pleasant is perhaps the best means—not a towel, which only removes the secretion from the labial and lingual surfaces and not from between the teeth, where decay is most rife.

How Few Children's Teeth are so Treated,

and how rarely the habit of doing it for themselves when they are old enough is inculcated. But if it be acquired, the very desirable result is likely to follow of an immunity from dental trouble—at all events to any large extent. Later on something more can be done, by passing a piece of waxed dental floss silk, which can be obtained of most chemists, between the teeth every day, and the value of this can be easily demonstrated after thoroughly using the toothbrush by passing the silk between the teeth, when a certain amount of accumulated matter will be brought away. "Do toothpicks do harm or good?" is another question often asked. They may do harm if abused, undoubtedly, by causing irritation of the gum between two teeth and its subsequent absorption; and, if made of wood, splinters are liable to be left behind, which have in many recorded instances caused even the loss of a tooth; but used judiciously they are of great value in routing the attacking forces in caries—namely, accumulations of food and mucous secretions. It has been urged against them that they might dislodge a stopping. But if a stopping is so insecure it

must be faulty, and the sooner it is replaced the better; for decay, due to the impossibility of keeping the surfacc clean, must be going on underneath it.

Mal de Montagne

or mountain sickness, is a complaint—occasionally fatal—from which those who make rapid mountain ascents suffer. It is due, the *Lancet* asserts, to the lower pressure of the atmosphere incident to lofty altitudes, or rather to the reduced oxygen pressure, whereby the gas is no longer capable of being dissolved in sufficient quantity in the blood of individuals accustomed to live in the plain. In such individuals, however, acclimatisation gives immunity from the *mal de montagne*, the circulation gradually increasing the number of the blood globules which, in greater mass, dissolve ever greater quantities of oxygen, and more than make up for the reduced pressure of the gas. It is to M. Paul Bert that we owe the experimental proof of this. Examining the blood of the llama or Peruvian sheep, he found that for every 100 cc. it absorbed, on an average, 20 cc. of oxygen, while in the herbivora of the plain the respiratory capacity of the blood did not exceed 15 per cent.

Atmospheric Depression

is, therefore, the cause that tends to increase the respiratory capacity of the blood in animals. The experiment above alluded to and others that confirmed it serve to explain the efficacy of certain climatic resorts in Switzerland, particularly in anæmic and chlorotic patients and in sufferers from neurasthenia. It is the atmospheric depression which, in conjunction with good hygienic conditions, acts on those invalids and promotes in their blood the formation of new sanguineous globules fit for the assimilation of oxygen. The more abundant nutrition and the augmentation of the appetite observable in a sojourn in the mountains are not the cause, but a consequence, of the improvement which such sojourn brings. Indeed, even admitting that the hæmatogenous action of elevated sights may owe something to other causes, it is difficult to resist the induction that climatic establishments are in general to be preferred to mineral water resorts—certainly to those whose reputation is chiefly built on fashion, on entertainments, or on the *ensemble* of adventitious attractions, from which health pure and simple has little or nothing to gain.

In the Practical Treatment of the Insane

England stands before every other country; in the scientific study of the insane no leading country is so backward. Elsewhere the exact study of madness is making rapid progress; it is beginning to be recognised that the great truth that knowledge means measurement (*scire est mensurare*) fully applies to the brain and nervous system. But in this country the rule-of-thumb method still reigns nearly everywhere. In the hands of a master of the art of healing mental diseases the rule-of-thumb method more often than not leads to perfectly reliable conclusions as to the mental status and condition of the subject before him, but it has two obvious disadvantages; it can only be trusted in the hands of a master; while even a master's mere impressions, however trustworthy, add nothing to the common stock of scientific knowledge. In actual practice, with our present knowledge of neurology (the nervous system), it is becoming a great advantage to the alienist who ministers to the mind distressed to be able to demonstrate that his subject is twisted in anatomical structure and perverted in physiological action; while, so far as science is concerned, in the end it is only accurate observation that counts. The study of anthropology is largely the study of manifestations of the brain, and it is to the increasing medical interest in anthropology that Mr. Havelock Ellis, L.S.A., looks for an increased knowledge by our physicians of the symptoms and accurate diagnosis of insanity.

Buried Alive

is what the ignorant Russian peasants allege is happening to the cholera patients, and the fearful riots in Astrakhan and elsewhere have been due to this belief. The origin of this delusion is thus explained by a Viennese physician, who says: "It is a striking peculiarity of cholera that the corpses of those who have perished by it are for some time after death subject to convulsive movements of some muscles, or even of whole groups of muscles. These phenomena appear about three hours after death, and last longer than three hours. Prof. Eichorst relates that on one occasion he had left a patient for dead, when, three hours later, he was told that the dead man had revived. He found that the muscles of the upper arms were giving short, quick motions, following each other rapidly, which were interrupted by contractions of the whole group of muscles, whereby the forearm was visibly contracted. The fingers were also distinctly observed to be moving, as though playing the piano. It was only after three hours that the movement of the muscles ceased. I myself had observed these muscular movements in the case of a railway official, who died some years ago in Vienna after twenty-fours of the illness. During the excessively rapid course of the disease in this case the motions had appeared in the facial muscles. Dr. Barlow had also recorded a case in which some time after death the jawbones began to open and shut. It has also been asserted that the strength of these muscular contractions is such that the corpses have been found within twenty-four hours to have shifted their position."

The Working Curve of an Hour

formed the interesting subject of a paper recently read in Vienna by Dr. Leo Bergenstein. To demonstrate the fluctuation of brain power in children, he collected two classes of little girls and two of little boys, the children's ages being eleven and twelve years, and set them to work on easy sums in arithmetic for successive periods of ten minutes, with five minute intervals of rest; then the results of the work, the calculations and the errors were carefully tabulated and compared. The total number of calculations made by all the children increased, roughly speaking, 4,000, 3,000, and 4,000 in the second, third, and fourth periods respectively. During the third period of ten minutes the increase of work done was not so great as at other periods; the number of mistakes also increased, say 450, 700, 350 in the different periods. Here again, during the third period the quality of the work was at its lowest. It would thus appear that children of the ages mentioned become fatigued in three quarters of an hour; that the organic material is gradually exhausted; and that the power of work gradually diminishes to a certain point during the third quarter of the hour, returning with renewed force in the fourth quarter. This experiment is regarded as demonstrating that continuous work for school children of these ages, even though the tasks are not difficult, ought not to last longer than three-quarters of an hour.

The Photographic Camera

has already made its appearance in warfare, but there is also another department of criminal detection in which it is equally useful. A hairdresser sends us this interesting

account of how he found out the thieves who stole his cigars during the night :—"A camera was arranged so as to cover the cigar-case, and a flashlight apparatus and a camera were connected by electric wires with the sliding-doors of the cigar-case, so that when the door was opened the wires would be brought together. The circuit thus formed would produce a flash, and secure instantaneously a picture of the thieves. For twelve days the cigars were unmolested, but on the morning of the unlucky thirteenth the thieves were prompted to try their hand again. When the barber came to business, his shop was full of smoke, and he rightly conjectured that he had had visitors. The back window was wide open, the trespassers having been in so much of a hurry that they had not time to close it, and the cigars were undisturbed. The plate was taken from the camera and developed, and on it was seen a unique and interesting picture, containing the likenesses of two juveniles who were in the act of stealing the cigars. Every detail in the shop was distinctly seen ; the clock showing the time at which the youngsters' little operations were interfered with, and the mixture of cunning and caution on the face of the boy who was evidently taking the active part in securing the booty, was intensely amusing. The boys were at once recognised, were arrested, tried, and sent to a reformatory, and the judge commended from the bench the ingenuity of the means of detection employed."

The Tides and the Weather

have aroused some interesting speculations in the mind of Mr. A. Egerton, who asks :—"Have any of the readers of SCIENCE SIFTINGS noticed the connection between high tides and wet weather ? In the Bristol Channel," he continues, "we often find that they both occur together ; and we can often predict the weather by observing the tides. For instance, supposing there is a slight shower, and we find that, at the same time, that the tide is high, we may predict that the rain will clear off as the tide recedes ; if, on the contrary, the water is at ebb and it is raining, the chances are that the rain will increase. This method is, of course, not infallible, but is nearly so, and it seems reasonable that the moon which attracts the heavy waters should attract the lighter clouds in the same direction."

Scientific Saddles

are treated of in a communication we have received from Mr. J. Charles King. He infers that fatigue in riding is due to the saddle having a forward stirrup, instead of a central one. He sends us the following utterance of a well-known English cross-country rider's experience in the Argentine. Says this gentleman :—"On a V-shaped stirrup-leather suspension, I rode 150 miles in one day, without being galled, fatigued, or the horse having a sore back. This is an English adaptation of the Spanish central stirrup hanging. Had it been an English saddle, I must have risen in the saddle over 60,000 times, and sat down in the saddle as many times, if the pace had been a trot all the way. As it was, I stood in my stirrups, with a slight spring of ankle and rise of body, without the distressing fatigue an ordinary English saddle would have caused me." He further says that "horseback accidents are rare in Argentine, though thousands of horses have to be 'backed' by riders for breaking-in yearly ; yet every hunting season in England yields a crop of six or eight deaths, and over 600 injured more or less seriously ; and, for grace of pose, there can be no difference of opinion the huntsman's 'toad-on-a-shovel' riding in England and the grace and dignity of the seat of the South American rider on the Pampas."

Has Change of Climate

within historical times brought about change of diseases ? This question is answered in the negative by many authorities, including Dr. Pye-Smith. We may assert that, with a few important exceptions, such as the draining which has led to the general disappearance of malaria, and the improved habitations of the poor, which have made plague unknown and typhus rare, no such changes have taken place ; and in particular that there is no foundation for the opinion that in former time the English spring was milder than at present. "The uncertain glory of an April day" was as uncertain at the close of the sixteenth as at the close of the nineteenth century. In the seventeeth century the great Earl of Verulum met his death from standing in the snow on Highgate-hill on Easter Monday, and Evelyn remarks, under date of March 27, 1681, "An extraordinary sharp spring, not a leaf yet on the trees." In the eighteenth century Horace Walpole writes that "the spring has set in with its usual severity" ; and the contrast between poetical description of the "ethereal mildness of spring" and its actual inclemency has become a commonplace of satire.

The Generation of Thunderstorms,

and particularly the primary cause of the constant negative charge of electricity on our earth's surface, is still an open question. Did the earth obtain it at the time of its primitive evolution from chaos, and has the charge been preserved since then, partially by an atmosphere which cannot contain, conduct, nor convey electricity, but principally by the vacuum beyond our atmosphere, such as at present we may obtain with our improved air-pumps, to such a perfection that it is an absolute non-conductor of electricity, through which not a trace of the earth's electric charge can possibly pass and be lost ?

Watery Vapours,

which frequently float in our atmosphere, are only receptacles of electric charges, and may obtain the negative charges of the earth's surface by direct contact ; for instance, when a mist or fog reaches the soil, in which case the earth's conducting and negatively-charged surface is transferred to the upper limit of the fog ; when, now, by air currents begotten by solar heat, the fog is caused to ascend and separate itself from the earth, by which it will be repelled (having the same charge), it will give origin to negatively-charged clouds, which then, in their turn, may act inductively upon other clouds. In the same way the earth acts, and causes the nearest portion of the neutral clouds to become positive and the most distant portions negative ; if then such clouds while under this inductive influence become split up by air currents, they give rise to clouds charged positively and others charged negatively, and it is seen how the inductive action repeated over and over again may, under proper circumstances, develop and multiply the charges and give origin to the thunder storms. This happens when the clouds discharge their excess of electricity to one another or to the earth, and so tend to restore the neutral condition, which is the electric equilibrium.

ALTHOUGH an ant is a tiny creature, yet its brain is even tinier. But, although it is necessarily smaller than the ant's head which contains it, yet it is larger in proportion, according to the ant's size, than the brain of any known creature. The best writers upon ants—those who have made the astonishing intelligence of these little insects a special study—are obliged to admit that they display reasoning ability, calculation, reflection, and good judgment.

GLEANINGS OF THE GLOBE.

A WIRE rope has just been manufactured at Newcastle for an Australian cable tramway 10,670 yards long. It weighs 36 tons, and is made in a single length.

THE Guadaloupe bees lay their honey in bladders of wax about as large as a pigeon's egg, and not in combs. The bees have no stings, are small, and of a black colour. The honey is of an oily consistency and never hardens.

AT the recent conversazione of the Royal Society, Dr. Gill projected on the screen a photographic star map containing the images of about 42,000 stars. As every star is a sun, we may infer therefrom something concerning the immensity of the scale on which the universe is established.

SPIDERS are not always solitary and selfish, some naturalists have asserted, as might be gathered from a recent "Gleaning." An authority on the subject, has told the British Association that "there really are cases in which the male and female spiders live in amicable relations for a considerable period."

THE mightiest of gunpowder blasts in connection with railway works, if not the greatest blast exploded, was that by which Sir William Cubit blew away, with one charge of 19,000 pounds of gunpowder, the entire mass of the Round Down Cliff, which rose to the height of 350 feet above the level of the sea, within a few miles of Dover. The dislodged stuff covered a space of more than fifteen acres.

THE POSTMASTER-GENERAL is very fearful, that the telephone service will some day seriously affect his telegraphic department. He has reason for his alarm. According to present signs the "telepham" will eventually cut out the "telegram." A French journalist advertises that he will telephone in his own language a message of about 400 words for a guinea (21s.), the charge for which under old conditions by telegraph would have been 66s.

SMOKERS who have some regard for their health will hail with pleasure the introduction of The "Biltor" Pipe, which is supplied by The Biltor Pipe Co., of 14, Holborn, E.C. The pipe is furnished with a removable absorbent cartridge which effectually prevents the passage of nicotine into the mouth, and the accumulation of moisture as with ordinary pipes. The pipe is sold at a shilling and the cartridges, which serve two or three times each, are supplied in boxes containing 50 for 6d.

WE have been asked: Which is the largest, the earth, the planet Mars, or the moon? Which is nearer to the earth, Mars, or the moon? The earth is the largest of the three, being three and two-thirds times as large as the moon and nearly twice as large as Mars. Mars is nearly twice as large as the moon. The moon is, on the average, 238,000 miles from the earth, while Mars is, on the *average*, 48,000,000 miles from the earth. At times the moon is much nearer to the earth, and at times much farther; so also is Mars, their orbits being not circular, but elliptical.

A NEW departure in the popular "go carts" is the "Victor Carriage," of the Victor Supply Company, of 167, Victor-street, Grimsby. It presents many desirable and hygienic features not to be found in other similiar contrivances. Instead of children being placed back to back, they are face to face, while legs and feet are well protected from cold. The car is constructed on scientific lines which promise well for its endurance. As a substitute for the perambulator, it is everything that could be desired, and certainly more healthful than any perambulator ever could be.

EXPERIMENTS made at the Royal Danish Academy have demonstrated approximately the height of the aurora borealis. M. Adam Paulsen, at Godthaab, by means of two theodolites situated four miles apart, found that different aurora displays varied from one to four miles in height. Experiments near Cape Farewell showed the height of different auroras to vary from one to ten miles. At Spitzenberg the range of height was from one-third to eighteen miles. In some of the earlier experiments in this direction the observers concluded that the height of auroras varied from 90 to 500 miles.

AN American scientist maintains that there is good reason to believe that climate will be seriously affected by the railway. He says that there are in the United States 170,000 miles of railway tracks, part of which are double. On these tracks 29,000 locomotives and 960,000 cars are constantly rushing hither and thither. He thinks that the conflicting effect of these perpetual rushings of a million cars in all directions through a mobile and elastic atmosphere will be much greater than the violent and temporary effect produced by a great battle. He thinks that railways may generate cyclones, and lead to unusual snowstorms.

A NEW system of protection for gunners in exposed places on men-of-war in action is to be adopted by the United States Navy Department. Experiments are now being made looking to the attainment of that object, and the best result obtained thus far is from a wire webbing made of intertwining spirals remarkably flexible and strong. It resembles somewhat the old-fashioned chain armour of the Crusaders' time, and curtains of this material will be used to protect gunners behind shields from fragments of exploding shells. The resisting quality of this network will be equal, it is confidently believed, to that of a solid plate of steel an inch thick.

The teredo navalis, or ship worm, is one of the most singular members of the insect world. It is a sea worm, whose head is provided with an exceedingly strong and hard armour, while the rest of the body is covered only by a transparent skin. Though very minute when it first comes from the egg, it often attains the size of 4 to 6 inches. It derives its name from the terrible havoc it makes on ships not provided with sheathing, for although the timbers may appear perfect, an examination shows that they are perforated in every direction, and to such an extent as to be a mere shell, incapable of resisting even a heavy wave. Some of the early European navigators to the East Indies and America were dumfounded at finding their vessels crumbling away beneath them, and, before discovery of the true cause, attributed the phenomenon to witchcraft. Trees borne down to the sea by the Amazon and other tropical rivers are, in a few weeks, so completely eaten through by these creatures that a blow with a stick will shatter the entire log into fragments. The worm is interesting to scientists from the fact that, from its particular method of boring, the famous engineer, Brunel, derived the idea of the pneumatic shield, which made the Thames tunnel a success.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 43.

181.—What are the peculiarities of the reputed "Valley of Death," in the East?

A real valley of death exists in Java. It is termed the "Valley of Poison," and is filled to a considerable height with carbonic acid gas, which is exhaled from crevices in the ground. If a man, or any animal enter it, he cannot return; and he is not sensible of his danger until he feels himself sinking under the poisonous influence of the atmosphere which surrounds him, the carbonic acid gas, of which it chiefly consists, rising to the height of eighteen feet from the bottom of the valley. Birds which fly into this atmosphere drop down dead; and a living fowl thrown into it, dies before it reaches the bottom, which is strewed with the carcases of animals that have perished in the deleterious gas.

182.—Have pieces of stone ever been known to fall from the air inclosed in hail-stones?

A violent hailstorm occurred in the year 1819, at Grignoncourt, in France, when hailstones weighing over a pound were collected; and the mayor and the clergyman of the parish reported that on dissolving them a stone of a clear coffee colour, of from 3 to 4-fifths of an inch in thickness, was found in the centre of each. These stones were flat, round, polished, and, moreover, perforated with a hole in the centre into which the little finger could be inserted. The *North British Review* has observed that "a great quantity of circular perforated discs, of a polished and transparent mineral, could only have come from a jeweller's shop in the moon, consigned to another jeweller in the atmosphere, who set them in ice for the benefit of the Mayor of Grignoncourt." But such a sceptical attitude does not commend itself to the writer. It is gratuitous to assume that the orderly arrangement of their parts is a quality possessed only by the larger masses of matter that have originated in celestial space. And, indeed, another fall of hail in which meteoric stones were inclosed was recorded in Russia in 1825. The stones were, in that case, sent to the Academy at St. Petersburgh.

183.—What kind of aquatic animal or vegetable life is it, the presence of which, apparently turns water into blood?

The phenomenon is caused by the development of myriads of purple conferva (*oscillatoria rubescens*) which forms a link in the chain between animal and vegetable beings. It is observed on the Red Sea; and on some inland seas it occurs regularly every spring, when the fishermen say that "the lake is in flower." It would not be impossible for a naturalist, were he to study the mode of reproduction of the *oscillatoria*, to convert the waters of any pond into a liquid resembling blood.

184.—What is the simplest method of preventing the intoxicating effects of drinking alcoholic liquor?

Bitter almonds have been used for this purpose with some success. They contain prussic acid—a volatile poison that is developed when the bitter almonds are masticated and received into the stomach, and that operates as a powerful sedative upon the nervous system, rendering the body less susceptible of the influence of excitants, consequently of wine. It forms, as it were, a balance in the opposite scale, and preserves the equilibrium, between the sinking which would result from its use were no wine taken, and the intoxication which would follow an excess of wine, were the bitter almonds not eaten. Plutarch informs us that the sons of the physician of the Emperor Tiberius knew this fact, and, although the most intrepid topers, yet they kept themselves sober by eating bitter almonds.

185.—What kind of fruit is the "apple of Sodom?"

According to Hasselquist, this is the fruit of the *solanum melongena*, a native of the valleys bordering on the Dead Sea. It is attacked by an insect (a *tenthredo*), whereby the whole of the interior is converted into dust, leaving the skin only entire, without destroying its form or colour. Other authorities state that the apple of Sodom bears only a very superficial resemblance to a fruit, and that, in reality, it is a kind of gall-nut formed by the incision of an insect upon the *pistacia terebinthus*.

186.—Can any scientific explanation be given of the fact that nutritive "manna" has been precipitated from the sky?

It is recorded that showers of a nutritive substance took place in Persia in 1823 and 1824. So abundant was the rain that in some places it lay five or six inches deep on the ground. The supposed miracle was explained when it was discovered that the "manna" was a well-known species of lichen, which the cattle and sheep ate up with great avidity, and which was also converted into very eatable bread.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

193.—How does light act in producing photographic pictures?
194.—Since the sun is in motion towards Hercules, how is it that the earth is not left behind?
195.—How are cheques protected against forgery?
196.—In what direction is it most probable that the present methods of producing power will be modified during the next century?
197.—What is the principle of the kalcidoscope?
198.—What is the *rationale* of bleaching?

VOLUME I. OF "SCIENCE SIFTINGS"

CAN BE HAD

Bound in Cloth and Gold, 3s. 6d. Postage 6d. extra.

Or from Messrs. W. H. Smith & Son, and through any Newsagent.

AN INDEX TO VOLUME I.

may be obtained on application to the Publishers, price 2d., post free 2½d.

Covers for binding Vol. I, price 1s., post free, 1s. 2d.

THE ELECTROPATHIC FRAUDS

WHAT OUR EXPOSURE HAS DONE.

The unsavoury electropathic frauds which we have been so studiously exposing for the past few weeks have not yet received the attention of the Treasury. We do not despair, however, for we learn of activity in certain quarters that must ultimately prove most disquieting to Mr. C. B. Harness, the president and principal of the Institution of that name in Oxford-street.

We have also the satisfaction of knowing that our disclosures have resulted in the saving of a considerable amount of money to the public, which appears to have freely taken our warning. Personally, we have also benefited by our action. The sale of SCIENCE SIFTINGS has increased very largely. The number in which we published our first charge against the Oxford-street Electropathic Institute was sold out on the day of publication, and we had to go to press with a second and third edition. We are aware that we owe many of these sales to the activity displayed by Mr. Harness's servants in buying up the copies as fast as they were printed; but we may inform this gentleman that we still have a very large stock of the papers on hand, to which he is welcome, for circulation among his clients, on payment of the published price.

The charges we have formulated are only a very small part of the serious accusations that are levelled against this gang of self-termed electricians. We hear of many who have suffered most seriously in health, and even of patients who have paid to the tune of £1,000 for cures that were, of course, never effected. In one case, the patient was allowed to become seriously ill, and then sent with a letter of introduction to a physician. Ostensibly, however, the patient was sent with a *private* letter of introduction, written by one of Harness's servants, which did not even purport to emanate from the Oxford-street establishment. Such a letter would have led, of course, to most undesirable inquiries by the physician to whom it was addressed.

We strongly urge upon all those who have had the misfortune to suffer from the misrepresentations of Mr. Harness or his assistants to immediately communicate with us, or to address some respectable firm of solicitors, with a view to the immediate return of the money out of which they may have been cozened.

In order that there can be no mistake about the establishment to which our comments refer, we publish the following copy of one of Mr. Harness's many traps to catch the unwary:—

RUPTURE.

By the aid of Mr. Harness's Improved Hernia Appliance hundreds of the afflicted who were cruelly tortured, and whose lives were seriously endangered, now live in comfort and happiness, and are able to perform their regular duties without any difficulty. A Hernia Specialist, of exceptional ability and experience, is in daily attendance at the

Electropathic Institute, 52, Oxford Street, W., where he may be consulted free of charge. Delay is dangerous.

The "hernia specialist of exceptional ability and experience" is an ex-salesman of furniture, who has never medically qualified, and the results of his interference has been increased agony and incapacity for all work. "Delay is dangerous," says the advertisement. On the contrary, we assert that the only danger to be anticipated is in a visit to the Harness Humbug Institute. A rational man will avert the risk by paying a visit to a respectable qualified medical man.

Any member of the public who may not yet have seen our exposure of electric-belt quacks, which appeared in our issue of August 6, is welcome to a copy of the paper containing it, on payment of one penny. If the existing edition runs out, we shall go to press with another, as we do not intend to rest until every individual in the world, before whom Mr. Harness's advertisement is likely to come, has been advised of the serious injury to health—and even danger to life—that may result from patronage in any shape or form of Mr. Harness's electropathic institution.

HOW TO KEEP HORSES.

A horse can live twenty-five days without solid food, merely drinking water; seventeen days without either eating or drinking; and only five days when eating solid food without drinking.

An idea prevails among horsemen that a horse should never be watered oftener than three times a day, or in twenty-four hours. This is not only a mistaken idea, but a very brutal practice. A horse's stomach is extremely sensitive, and will suffer under the least interference, causing a feverish condition.

Feeding a horse principally on grain and driving it five hours without water, is like giving a man salt fish for dinner and not allowing him to drink until supper-time—very unsatisfactory for the man.

If you know anything about the care of horses, and have any sympathy for them, water them as often as they want to drink—once an hour, if possible. By doing this, you will not only be merciful to your animals, but you will be a benefactor to yourself, as they will do more work; they will be healthier; they will look better; and will be less liable to coughs and colds, and will live longer.

If you are a sceptic, and know more about horses than any one else, you are positive that the foregoing is wrong, because you have had horses die with watering them too much, and boldly say that the agitators of frequent watering are fools in your estimation, and you would not do such a thing. Just reason for a moment, and figure out whether the animal would have over-drank and over-chilled its stomach if it had not been allowed to become over-thirsty. A horse is a great deal like a man. Let him get overworked, over-starved, or abused, and particularly for the want of sufficient drink in warm weather, and the consequences will always be injurious. Sensible hostlers in large cities are awakening to the advantages of frequent watering. Omnibus horses are watered every hour, and sometimes oftener, while they are at work. It is plenty of water that supplies evaporation or perspiration and keeps down the temperature.

What old fogey methods amount to may be seen by the change in medical practice to man. Twenty years ago a person having a fever of any kind or pneumonia was allowed but little water to drink, and then it had to be tepid. To-day, practitioners prescribe all the iced water the patient can possibly drink; and in addition, cold bandages are applied to reduce and control the temperature of the blood. What is applicable to man will never injure a horse. Use common sense and human feeling. Do not think it is a horse and capable of enduring any and all things. A driver who sits in his wagon and lashes his worn out, half-curried,

half-fed, and half-watered team should never complain of any abuse he may receive from his master or employer, for he is lower in character, harder in sympathy, and less noble than the brutes he is driving, and deserves, in the name of all that is human, the punishment of a criminal.

RECENT RESEARCHES IN CRIMINOLOGY.

It has recently been said by a prominent anthropologist that our modern civilisation has so improved that it exceeds the natural capacity of many individuals who live in our midst. Modern civilisation represents the last and final effort of the individuals who are the best equipped. Many persons who now might be regarded as more or less criminal would have been esteemed honest if they had been destined to live in the primitive civilisation of ancient times, when our ancestors formed the barbaric races of Europe. It cannot be denied that we are not born to the high moral standards now set up for our guidance. We are, on the contrary, born with the crude moral perceptions which have come to us through the many centuries of semi-barbaric living, and our fitness for living in accordance with the teachings of these last decades is largely dependent on our environment and training.

It may well be said, in the words of Lacassagne, that "society has no criminals except such as it merits." In other words, the care taken by society to prevent criminal development and propagation is not commensurate with its desire to formulate laws based on its advanced ideas of what constitutes crime. So it comes that the laws made by the very respectable and powerful minority are far in advance of the inborn tendencies or acquired powers of the vast majority of mankind. Naturally, therefore, the criminal, or, in this light, least capable man is the victim by that much of what thus becomes to him class legislation, and, in the words of M. Alimena, "the criminal is produced by the same processes as are employed by stock-raisers to rear new races as an improvement of the present races." By driving them together in mutual sympathy and for mutual protection, society places a premium on the interbreeding of criminals, and thus assures the perpetuity and intensification of the breed.

It is this line of thought that has made the work of the criminal anthropologist of vital interest in recent years to all who are, however remotely, engaged in watching the advancement made by political science in the amelioration of human misery. It has been clear to many that if men are born criminals, or if they are what society makes them, in either case there is a crying need for radical changes in our criminal jurisprudence. If they are born with a bias toward crime, then, in many cases, the hospital or asylum is more fitted for their reception than is the prison. If, on the other hand, the manufacture of the criminal class is a matter of education and surroundings, then it is high time that there should be sweeping changes made in both these creative causes. It must be evident to all that at present no question can surpass in importance those which have to do with the pathology of crime.

In Rome, in 1865, there met, for the first time, an association of delegates from all quarters of civilisation, who organised themselves into the International Congress of Criminal Anthropology. Again, in August, 1889, at Paris, this association met, and continued with renewed vigour and interest the discussion of many questions of importance. Fortunately, an epitome of their proceedings has been given to the scientific world in the annual report of the Smithsonian Institution (U.S.A.), for 1890, but, unfortunately, it has of necessity in that form but a limited circulation. Therefore, it has seemed to be worth while to give here a brief *resumé* of the more salient features of the discussion, with such comments from other sources as may be germane thereto.

Since 1885 it has been apparent that the students of criminal anthropology were divided into two schools, called usually the Italian and the French schools. The first of these, led by Prof. Cæsar Lombroso, whose more recent researches and conclusions have frequently appeared in SCIENCE SIFTINGS, with the majority of the Italian students as a following, are firm adherents of the doctrine of the permanence of the criminal type, the physiological as well as psychical differentiation of the class, and all those minor laws which depend from these postulates. The French school, on the other hand, is that in which the majority of the observers from that country are led by Dr. Manouvrier. To them sociological conditions are sufficient to explain the vast and multiform problems of criminal psychology.

During the congress of 1889 the skull of Charlotte Corday, "which belonged, with all guaranty of authenticity, to the collection of Prince Roland Bonaparte," was the main object of contention over which this battle was more than once fought. It was presented as the skull of a criminal born in which the depth of the occipital fossettes was an illustration of a marked characteristic of the type. To which it was replied that such a character could by no possibility signify anything, and that if Charlotte Corday was by this sign a born criminal, "then, instead of being a heroine who rid the world of a monster, she was naught but a common, vulgar, impulsive murderess." This was a veritable battle-royal to which the leading lights of the science throughout civilisation contributed from their vast store of knowledge. Yet, it was more than once apparent that the differences between these schools were more those of argument than of actual fact, for it was plain that there was a common ground on which all could meet, as will be seen later on.

In opening the case for anatomical and physiological differentiation on the part of the criminal class, Prof. Lombroso found differences existing between the criminal of occasion and the criminal born. In the former he found "his sensibility less obtuse, his reflexes less irregular, the anomaly less frequent, especially in the skull." Certain of the characters of the criminal born, however, were always present, "such as the blackest hair in the servant who is a thief, awkwardness more frequent among swindlers, and that all are more governed by impulse." In commenting on his examination of the photographs taken by Mr. Francis Galton, Prof. Lombroso spoke as follows :—

"I have found in eighteen skulls of condemned persons two types which resemble marvellously, and with an exaggeration which is evident, the characters of the criminal and approaching those of the savage. Frontal sinuses well-marked, cheek and jaw-bones very large, orbits large and distant, an unsymmetrical face, the nasal overture of a pheleiform type, and the lemurian attachment of the under-jaw. The other skulls of the swindlers, thieves, and robbers gave me a type less precise, but the want of symmetry, the great size of the orbits, and the prominence of the cheek-bones were well-marked, though less than in the former cases." In comment, M. Bajenoff stated that his cephalometric studies had led him to believe that "honest men had a larger frontal development, while the criminals were better developed in the parietal and occipital portions of their brain or skull."

In introducing the question of "the organs and functions of sense among criminals," Dr. Frigerio announced that he had, in a large series of examinations among the criminal and non-criminal classes in Italy, encountered a predominance of the chestnut coloured iris among criminals, and a considerable proportion of blue among violators or offenders against public morals. Visual acuteness he found much more developed among the criminals; while the sense of smell was inferior, as was also the sense of taste. On the other hand, however, the sense of hearing among 280 criminals examined in prisons was found to be abnormally acute. Of this faculty Dr. Frigero says: "It is without doubt true that the disuse of one sense will serve to sharpen another. As is the sense of touch among the blind, so is the sense of hearing among those prisoners who are condemned to silence. . . . It has come to be known definitely and certainly that they communicate with each other by means of a tapping or striking upon the wall or other substance. This sort of telegraphic communication may be likened unto the old Morse alphabet. . . . Thus it happens that a prisoner will continue his work even in the presence of the guard who is watching him, yet by the strokes which he may make in his work he can communicate with the other prisoners who may be within earshot, and it does not seem to make much difference to them whether the surroundings are in silence or amidst a deafening noise. . . . Although the guardians wore slippers shod with cloth or felt, intended to enable them to walk noiselessly, yet every criminal detects the difference in the step of the various guards so as to tell which one is approaching. . . . If the sharpness of hearing among criminals is engendered by the inertia or disuse of the other senses, such as taste and smell, which were somewhat obtuse, we were unable to find any physiological or anatomical evidence of it in the brains of those whose autopsies we made."

Other characteristics were referred to by Prof. Lombroso and others as being common to many criminals; among these, hernia was stated to be prominent, and the "role of ptomaines in criminal manifestations appeared certain." Ottolenghi found facial wrinkles more marked in criminals; especially was this so in the case of the naso-labial wrinkle, which he regarded as a characteristic. He had also remarked a great retardation in both baldness and grey hair in the criminal classes. Lombroso stated that in criminals the average temperature was much above the normal. An analysis of the urine of the born criminals yielded a larger proportion of phosphoric acid and less of azote. Dr. Brouardel related his observations made on an epileptic woman in his service; her urine contained a ptomaine, which, when injected into a frog, produced the same physiologic effects as strychnine, *i.e.*, convulsions. Lombroso also called attention to the repeated cases where epilepsy was accompanied by a total absence of the moral sense. This, in his opinion, found as it is "with erethism or exaggerated sensibilities, explains how some persons, criminals because of their passions, have many times an unconsciousness of their own criminal acts."

It is principally among those suffering from alcoholism, hysteria, and monomanias, that epilepsy became a marked factor in the criminal insane. Commenting on these statements, M. Benedickt gave it as his opinion that "criminals were sick men either in body or spirit; and if one examines the exterior morphological signs to explain and account for the existence of crime in the conduct of a given man, it was equally necessary to investigate the molecular trouble in his cerebral structure." Madame Clemence Royer called attention to hybridity as a hitherto unconsidered factor in the genesis of crime. The mixture of races, the mixture of blood of different races, one of which was usually, if not always, inferior, was, in her opinion, a factor of prime importance.

(*To be concluded next week.*)

IS PERPETUAL MOTION POSSIBLE?

The reply to this question depends entirely upon the limitations put upon the term "perpetual motion." If we understand these words to mean a machine that would start itself, furnish power for doing work, and continue in operation so long as required, or until worn out, without the assistance of any external agency, we may say, with the utmost confidence, perpetual motion is impossible.

If, on the other hand, we define perpetual motion as a machine dependent for its action upon the variability of one or more of the powers manifested by Nature, we may say perpetual motion is possible. The thermal motor, in which expansion and contraction are produced by natural changes of temperature, is an example of a motor of this kind. In this machine, the changes in volume in a body, subjected to variable temperatures, are made to store energy to be used in continuous regular work. A perpetual clock has been made on this principle.

Sun motors of various forms have been devised, which might be used in connection with storage mechanism for furnishing power continuously. A sun's heat motor of sufficient size, with a suitable storage system, could furnish power all the year round in almost any part of the world; success being a question of hours of sunshine and capacities of motor and storage system.

Of course, what is said with regard to the sun motor applies with equal force to water wheels, windmills, tide and wave motors. Without doubt, all of these prime movers will come more and more into use as time advances and storage systems are perfected. Still, they do not satisfy the seeker for the ideal perpetual motion. This should fill the conditions first mentioned; but, as we have already said, this is an impossibility.

The first and strongest reason for making this positive assertion in regard to the ideal perpetual motion is found in the fact that never in the history of man has he been able, as far as can be ascertained, to make a single atom of matter, or create the smallest fraction of a unity of energy.

All the works of man, of whatever name or nature, have been constructed of materials already in existence, and all the work done by man and his enginery has been accomplished by using ephemeral natural forces, such as the gravitation of water, the power of the wind, the heat energy of the sun, or the stored energy of coal and other fuels, or of chemicals.

Having the command of some of Nature's forces, inventors have sought to circumvent her laws, so as to make water "run up hill," to cause masses of matter to act alternately in accordance with and in opposition to the law of gravitation; in short, to deprive matter of gravity while ascending, and cause it to act with the full force of gravity while descending.

Among perpetual motion devices of this class, proposed and tried, is the one having weights arranged on a wheel in such a way as to fall outwardly, and increase the leverage on one side of the wheel, while they fold in and diminish the

leverage on the opposite side of the wheel. This machine, it is needless to say, has never moved on its own account, although it has become classic. In this device, the superior number of weights on the side where the leverage is least, exactly balances the weights at the ends of the extended arms. This is true of all the modifications of this type of machine.

A favourite device of the perpetual motion inventor is that of weights arranged round the periphery of a wheel, and counterbalanced by springs on which gravity has no effect. Such weights, being balanced, are supposed to be capable of being moved upwardly in opposition to gravity without the expenditure of much power. After having been elevated, the weight, while maintaining its position relative to the wheel, descends, causing the rotation of the wheel. After it has done its work, the weight must be restored to its original position before the operation can be repeated, and here comes the rub. Many very ingenious plans have been tried to accomplish this, but the result has always been a perfect balance.

In another device, the attempt is made to utilise the Archimedean screw to elevate water to be used for driving itself. The inventors, in this case, fail to notice that, although the water is running down an incline in the screw, this incline is always being elevated, so that the water must be actually carried up an inclined plane by a force as great as it would exert if allowed to descend through the same distance. In all these cases, friction is left out of the question.

Capillarity has been tried as a means of elevating a liquid to be used as a motive agent, but, in this case, as in all others, the defeating element is present—the surface tension of the liquid prevents detaching the liquid from the upper end of the capillary conductor.

It seems strange that in these days the proposition should be made to run an electric motor with a current from a dynamo, and to operate the dynamo by the power derived from the electric motor, yet, absurd as this proposition is, it has often been broached in good faith. A mere superficial examination of this subject shows that the losses incurred in transforming the current into motive power, and, *vice versa*, are such as to defeat any attempts of this kind.

The permanent magnet appears to have suggested itself to many as a possible solution of the problem, and experimenters have searched the world over to find an insulator of magnetism to act as a cut-off for releasing the armature after it has been drawn forward towards the magnet; but no such material has been found. Nature, in this case, as in all others, refuses to yield energy without its full equivalent of work in some other form, and the law of the conservation of energy is found to hold good.

We have mentioned but a few of the multitude of devices constructed with the hope, not to say expectation, of producing a self-moving machine by the utilisation of natural forces.

Although the efforts of inventors in this direction have been barren of results of the kind aimed at, yet their labour has not been fruitless: many experimenters who considered actual trial better than any amount of study or calculation have learned that knowledge is taught by experience, and, while discovering the fallacy of the ideal perpetual motion, they have been led to study more practical subjects, and to make inventions which have proved beneficial to the world and profitable to themselves.

If the inventor of machines intended to be self-moving will not accede to Newton's statement that "action and reaction are equal and opposite" (third law of motion), and that the forces of Nature are constant, let him thoroughly acquaint himself with the principles of physics, and he will ere long be able to say with certainty just how the balance occurs in any and every perpetual motion machine of the ideal kind, and will admit that he has not the power of creating energy.

SINGULARITY OF SPIDERS.

The form of a spider is familiar to everyone. Even the smallest children know how they look. Still, it is said, there are persons so unobservant that they could not tell without another chance to count them just how many legs a spider has. But, outside the people who seem to see without seeing, there are doubtless others who do not know very much about their internal economy. To these it may be a surprise to learn that spiders are hatched from eggs, as chickens are—in perfect form, though very small—and, consequently, cannot be reckoned among the insects.

They are possessed, like ourselves, of a liver and pulmonary system, the latter consisting of from two to four lungs, through which they breathe. They have also a nervous system, a well-organised brain, and some of their senses are wonderfully developed. Can they lay claim to a mind as well? This has latterly been half conceded to the ants and bees. If it be true of them, spiders, too, may surely put forth their claim, for there is no denying that they often act like beings possessed of reason.

Some naturalists classify spiders by the number and position of their eyes; others in accordance with their nests and habits. While the last may not be the most strictly scientific course possible, it has the great advantage of being easily understood by a large majority of people. Walckenaër divides them into four principal groups, of which he places the hunting-spiders first. This name he gives to all those spiders which habitually sally forth in the vicinity of their homes in quest of prey. The group is a large one, and, although all of its members have this trait in common, they differ widely in other respects.

While some hunting-spiders build for themselves luxurious abodes, dwelling daintily in chambers tapestried with silks softer than are attainable by man, others are content to shelter themselves in some rough crevice or fissure of rock or tree, or hide beneath a mass of dead leaves. Some are distinguished for their extraordinary speed in running in pursuit of game; others for their wonderful powers of leaping to seize upon their quarry. Livingstone tells of a small spider which he found in South Africa whose leap measured a foot in length.

Among the group we find water-spiders, which, skimming lightly over the surface of the water, pirate-like, snatch up the hapless insects upon which they feed; and their first cousin, the sailor-spider, which builds a raft of weeds bound together by silken cords spun from its own spinnerets. On this she sails here and there as she may be wafted by the breeze, picking up her spoils as she goes, in the shape of some water-insect which has approached the surface, or one from the land, which, having ventured forth, is struggling wildly to keep itself from drowning.

The leaping-spider, in its mode of hunting, reminds one forcibly of the devices employed by the cat family. It will lie concealed within its nest, watching with a long patience

for the coming of its prey. When it appears, the spider creeps stealthily forth, approaching with the utmost caution, advancing, retreating, moving to the right or left, as the insect moves, till near enough, when, jumping—usually sideways—it pounces with a sudden, tiger-like leap upon its victim, secures it, and then carries it away to eat at its pleasure, or to preserve for future use, as necessity may urge or fancy dictate.

The largest of all the hunting-spiders is the *Mygale avicularia*, or bird-catching spider, of Surinam. When Madame Mérian, who was the first to report this monster to the scientific world, sent home her drawings of it, she aroused a storm of indignation. Many naturalists declared her descriptions to be greatly exaggerated, even if they were not inventions altogether; but long since her accuracy has been fully proved. This huge spider has a black body 2 in. in length, which is thickly covered—as the legs are also—with red and grey hairs, coarse and bristling. Its feet, when stretched, outline a circle of nearly 12 in. in diameter. Its head and thorax are protected by a horny shield. Each of its eight feet is armed with two stout claws, toothed like a saw. The hooks of its frontal claws—often incorrectly called mandibles—are conical in shape, very strong, and of a polished, shining black. Dampier says of a mygale found in Campeachy that it had fangs an inch long, "black as jet, smooth as glass, and, at their small end, as sharp as a thorn." These many people carry about in their pockets, and use for the purpose of cleaning their pipes, or sometimes as toothpicks, having a belief that their contact will prevent toothache.

This hairy monster, coarse and repulsive as she is in person, proves to be a very Sybarite in person. Probably for the purpose of concealment, she utilises for the outer walls of her dwelling some crevice of a tree or rock, or even may excavate a long, tortuous, subterranean tube, which she always narrows to a cone at the inner end. But this unpretentious shell is lined inside with white silken tissues of texture so fine and transparent as to look like woven glass, while to the touch they are of a softness as delicate as if the end of each rough hair upon her body was endowed with a more dainty sensitiveness than the skin of a new-born babe. This silken chamber, designed alone for her domestic luxury, is held too sacred to be sullied by contact with the labours of the spider's life. It is her home—a "godly bower," in which our ugly female Quilp lies at ease, as if she was a worshipful dame of the most luxurious type.

But, like some of these *fainéantes*, she can, and does, lay aside all her languor, and puts forth surprising powers when she feels that the necessity for action has truly come. While scorning plebeian toil, she by no means disdains the chase, which brings her both sport and food. She cunningly stalks her game, whether it be insect, bird, or beast, and, finally, bounds upon it with a ferocity so great as to insure success, killing small birds and even the lesser vertebrate animals. Latreille says of a West Indian mygale:—"The muscular strength of this spider is very great, and it is with difficulty made to let go whatever it seizes, even when the surface scarcely presents a hold for the claws with which the tarsi are armed, or for the fangs which assist them to kill birds and lizards." If the game is too large for immediate consumption it is "hung" for future use—suspended by strong cords of silk. Reed and cane birds are often found dangling from some branch, which has thus been pressed into service as a larder.

Mygale Florida, a near relative of *avicularia*, makes her home exclusively in the everglades of Florida. There she hunts all of the larger insects; but in the great southern cockroach she finds her dearest enemy and special *bonne bouche*. This insect, which does battle by standing erect and wrestling with his assailant, frequently proves himself a foe well worthy of her best endeavour. If the spider should chance to lose a limb in the fight, the mishap is not irremediable, for another will grow in its place. In fact, spiders are tough little creatures in many respects. They are capable of being incredibly abstemious under stress of circumstances, living for a very long time when entirely deprived of food.

The trap-door spider (*Mygale cunentaria*), another member of the same family, is found in Jamaica and some of the southern parts of Europe. This spider is of somewhat smaller size than its American cousins, being only about an inch and a half in length; but in taste and habits she closely resembles them. For her house she digs a tubular gallery in the earth, running to the depth of at least two feet, but of a width only sufficient for her convenient passing. The earthen walls she first covers with a coarse, grey, paper-like web, which reminds one of a wasp's nest. Then comes an inner lining of silk, as fine and soft as in the dwellings of *avicularia*. But this is not all. Our mygale provides for contingencies. Dangerous or impertinent guests might intrude uninvited within the sacred limits of her home.

To prevent this she constructs a door, artfully made rough as to its exterior, but lined with her dainty satin web, and hinged with many silken cords of astonishing toughness. The door is so cunningly hung that it shuts by its own weight after the spider has passed out for a hunting expedition. Upon the side of the door opposite the hinge, where we might place a bolt, is a curving row of tiny holes. Should any creature attempt to open it by force when the spider is within, she rushes with great speed to its defence, drives her claws into these holes, and, pulling down with all her strength, forms in her own person a fastening of surprising efficiency. The trap-door spider is nocturnal in her habits. She seldom leaves her dwelling by day, but prowls about and hunts her prey only during the darkness of the night.

The name *spider* is of Anglo-Saxon origin. It is peculiarly applicable to the large group of web-makers, being derived from the word *spinan*, to spin, and is written by some old authors *spinners* or *spithers*. It would, however, scarcely have been chosen for the hunting-spiders, had the family possessed no other branches.

The feathers of the greatest interest of birds, mechanically, are the large end feathers of the wings, the tail feathers being of no use, but rather a hindrance, in swift, steady flight; a pigeon, for example, always shuts its tail as closely as possible in flying across country. The tail is only used for turning, and for support in slow flight, as in commencing to fly or in alighting, so that if the angle at which the tail feathers strike the air is one or two degrees away from the angle of greatest economy it is not of much importance; but with the wing feathers the case is quite different. Here, if the angle were a quarter of a degree away from the best possible, it would be quite ruinous to any swift flight.

If you have an idea for a patent, write to the Editor of Science Siftings, giving the outline of your scheme. The communications will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

MARS IS UPON US.

Mars, our nearest neighbour among the planets, has been nearer to us during the past few days than it has been for fifteen years. Probably every large telescope in the world has been directed upon it in the hope not only of learning more about our sister planet, but of obtaining new light upon our own future history.

There seems to be sufficient evidence that the giant planets, Jupiter and Saturn, are yet in a heated condition, making life there impossible. Our moon, on the contrary, is a dead world; whatever life may have in some former epoch existed upon it having long since ended. Its seas are dried up, its atmosphere absorbed, and all the conditions of life, animal or vegetable, wanting. Our earth has passed through a stage in which life was impossible, and may be approaching a stage in which it will again become impossible. The planet Mars appears to be in such a condition as the earth may possess millions of years hence. It has reached that condition before us from its smaller size, becoming more rapidly cooled off. The earth was probably once covered with water. At present two-thirds of its surface is covered by its oceans. But in the planet Mars the drying up process has proceeded so far that oceans have dwindled to seas, and the land has become continuous. Our continents are islands; and we cannot visit our neighbours without crossing the sea.

In Mars, while there may be islands, there is but one continent; for nearly all the land upon the surface of the planet is so connected that, notwithstanding the existence of extensive seas, connecting with one another over a large portion of the planet, nevertheless the lands also are so connected that the principal part of the planet could be visited without crossing the water. In Mars there is an atmosphere, shown by the spectroscope to resemble our own; there is water; there is land, visible even in very small telescopes; there are icecaps at the poles varying in size with the season of their year, showing conditions very similar to our own. Clouds have been seen covering certain continents, and afterwards disappearing. All the indications point not only to the possibility, but to the probability of the existence of life there. There may be not only vegetable life, but animal life. And as it is in advanced stage of development it seems not unlikely that there may be human beings there; by which is meant, animals possessing the power of reason.

Is it possible to communicate with such beings? The only means of communication yet known to science are through the sense of sight. If there are astronomers in Mars who have foreseen our close proximity during this year they may have made preparations for it. They might erect in some conspicuous place an equilateral triangle which could not be attributed to natural formation; or, as has been suggested, they might give us a still more complete proof by erecting a structure corresponding in form to the demonstration in Euclid, that the square of the hypothenuse is equal to the sums of the squares of the sides of a right-angled triangle, which would prove their acquaintance with geometry. But why should they do this, when it would be so difficult for us to reply?

At the very time they are the most easily seen by us we are so nearly between them and the sun as to be almost if not quite invisible to them. If we know that they possessed a telescope large enough it would be exceedingly difficult for us to construct a geometric diagram which they could see at the distance the earth would be when it had escaped the sun's rays. They might well forego the attempt to communicate with us, knowing that, added to the uncertainty of our ever perceiving it, is the almost positive certainty of our being unable to reply to it.

The two extremely minute moons of Mars were discovered by Prof. Hall at the National Observatory of America in August, 1877. Since that time there has been no discovery of a third moon. The question then arises whether the discovery of one or more additional satellites may not be among the results of the observations of the present year. It seems impossible that there should be a satellite revolving in an orbit within that of the inner satellite of Mars already known. The extreme closeness of this satellite to the planet, and the consequent extreme shortness of its period of revolution, occasion some anomalous circumstances.

Writing on August 30, 1877, after the official announcement of the discoveries, a well-known astronomer said:—

"There are some curious circumstances with reference to the newly discovered satellites of Mars which have not yet been published, arising from the shortness of their periods of revolution. The outer satellite revolves in thirty hours, fourteen minutes, or, in martial time, thirty-two hours, four minutes. While Mars is revolving upon its axis once, this moon goes about three-fourths of the way around; so that, if it rose with the sun this morning, to-morrow morning it would have only reached the meridian, and would not set until the next morning, when it would remain for two days below the horizon; so that it would be four days, less forty-two minutes, before the satellite would rise again. But it goes through all its phases—new moon, full moon, last quarter and new moon again—every thirty-two hours, or three times during one diurnal revolution. Rising with the sun, as a new moon, this morning at 6 o'clock, it would be full moon at 10 p.m., before it reached the meridian; new moon again at 2 p.m. to-morrow, soon after passing the meridian, and full moon again when it set, at 6 o'clock the next morning.

"The inner satellite revolves in seven hours, thirty-eight minutes, equivalent to eight hours six minutes, martial time. This is nearly three times as fast as the planet itself revolves on its axis, so that the diurnal motion of this satellite is towards the east, rising in the west and setting in the east. If it met the sun on the meridian to-day it would set in the east, pass around the planet, rise in the west, and again reach the meridian thirteen minutes after midnight, and, passing entirely around a second time, reach the meridian at twenty-six minutes after noon. During this time it would have passed through all its phases three times.

"Although Mars has two moons, and, perhaps, three, it has not a moon like ours, following the sun and stars in the diurnal motion and changing in form and position but little at each revolution. Their changes resemble those of the insects that live but a day; and their apparent motion is in the one case so slow as to be almost at rest in the heavens like a beacon light, and in the other in a direction contrary to that of the sun and stars and contrary to all our experience of celestial motion."

In addition to the proximity of the nearest satellite, leaving no room for another, there is the additional evidence that although the satellites have been seen in the great Lick telescope when only one-eighth of their brightness at their first discovery, and have been carefully observed from the time of their discovery by other great instruments, no other satellite has been discovered. On the other hand, it must be remembered that sixty years elapsed after the discovery of the seven old satellites of Saturn before the discovery of

Hyperion, and that this eighth satellite was discovered, not within the inner satellites before known, but in an orbit between the two outer satellites. The chances for the discovery of an additional satellite of Mars appear to rest wholly upon the space outside of the known satellites. It must be extremely minute to have escaped detection, since at every revolution it must have been twice for a short period close to the planet when passing between us and the planet and again when passing behind the planet.

Telescopic stars frequently occupy a similar position, and such minute stars could not be found upon any chart or in any catalogue; and yet it seems incredible that a satellite should not have excited suspicion if seen at all, and, still more incredible, that if suspected it should have escaped the scrutiny which would naturally follow, since in an hour, or even less, its motion might be observed. The question then seems to be narrowed down to this: What is the probability that there exists a satellite sufficiently bright to be seen under the exceptionally favourable opportunities of the present year, but not bright enough to be seen at ordinary times, and that such a satellite will happen during the observation of Mars with the largest telescopes to come into such a position as to be suspected. We think there is far greater probability of the supposed discovery of a satellite which does not exist, from the observation of some telescopic star, than of the genuine discovery of a new satellite.

If such a satellite exists, whence did it originate? From the breaking up of a ring, according to the nebular hypothesis of La Place? Or from the capture of some meteorite flying through space? Either theory is fraught with difficulties well nigh insurmountable. But as we have not yet succeeded in ascertaining the origin of the satellites already known to exist, it may be well to heed the advice of Mrs. Glass on cooking a hare, "first, catch your hare." First let us catch the new satellite in the telescope before we rack our brains with theories to account for its existence.

The first observations of Schiaparelli, which have attracted so much attention, were made 10 years ago with a telescope of only 8 in. aperture, and have been partially confirmed by other observers during subsequent oppositions, and with much larger apertures. The so-called "canals" had long been known to exist, although the term has been only used for convenience, since we have no means of knowing that they contain water. The peculiarity noticed by Schiaparelli, Perrotin, and other observers, is that lines parallel to the canals are seen in many cases, forming what is called the duplication of the canals. The importance of this discovery consists in the fact that these duplicating lines are not permanent, but are subject to changes apparently corresponding to the season of the year in Mars, the lines making their appearance soon after the spring opens, lasting during the summer, and disappearing upon the approach of winter.

Observations of our own moon show great changes at different times, owing to the angle with which the sun's rays strike the mountains and valleys; and it is not impossible that the observed changes in Mars arise from some similar cause. The presumptions, however, are in favour of the theory that it is the growth of vegetation which causes the lines to appear, and the falling of the leaves which causes them to disappear. It is in order to determine by an accumulation of facts whether this is the true theory, and whether we have this visible evidence of the existence of vegetable life upon our neighbouring planet, that every large telescope all over the world is now probably directed to the planet to confirm and to add to the revelations already made.

Small telescopes will show the oceans and the continents of Mars much better than at ordinary times; but any telescope, in a favourable location, with an aperture of eight inches or more, may aid in giving us testimony upon this point of vital interest. While much depends upon the telescope, much also depends upon the observer, and upon the attention of the observer being directed to the point to be examined. It usually requires a very much smaller aperture to see an object once discovered than was required to make the original discovery. And still more depends on the nearness of the planet. If the advantage of a telescope were in proportion to its aperture, 28 inches aperture now would be equivalent to 36 inches aperture two years ago. But, owing to the increased thickness of glass to be traversed, and other causes, still smaller apertures can now show more than could be seen in the Lick telescope when Prof. Holden declared that he had had such view of Mars "as no other astronomer ever before had." And yet the Lick observers will retain their pre-eminence. While from others we may expect many additional facts, it is still to the Lick Observatory that we must look for the best evidence of the condition of our sister planets.

It was not until three months after Mars was nearest to us in 1888 that it was possible to make regular observations at the Lick Observatory. At that time the earth had passed so far away from the planet that the advantage of that immense telescope could not be utilised. It was two years before the earth again overtook Mars in its passage around the sun, and at that time its distance was so great that it was necessary to wait two years more for the opposition of 1892, and now the circumstances are more favourable than for many years past or for many years to come. On June 26 we had already approached as near to Mars as when nearest in 1890, and ever since that date the observers at the Lick Observatory have had a better opportunity to scrutinise the appearance of the planet than anyone has ever before had. Comparing the surface of Mars when nearest during the first few days of this month, with its surface when nearest two years ago, it was two-thirds larger, and gave us a relatively plainer view of the details upon its disc. Under the best possible circumstances, the surface cannot become more than one-twentieth larger than at the present opposition, the most favourable date of which occurred on the 26th inst., so that we can hope for nothing more than can now be seen, until some more powerful telescope shall be constructed.

REMARKABLE SONGSTERS.

The bell bird or campanere, which is found in South America and also in Africa, Waterton, the famous traveller and naturalist, states, can be heard at a distance of three miles. Its note is like the tolling of a distant church bell, and is uttered during the heat of the day, when every other bird has ceased to sing and nature is hushed and silent. How the bell bird utters this deep loud note is not known, though it is supposed that a fleshy protuberance on its head, which, when inflated with air, stands up like a horn, is in some way the cause of it.

The hornbill, a bird which is widely distributed in India, the Malay Archipelago and Africa, has also a very loud note. Its call has been described as "between the shriek of a locomotive and the bray of a donkey," and can be heard a distance of about a couple of miles. The barking bird also utters a very loud note; indeed, it is impossible to distinguish it from the bark of a dog. Its English name, says Darwin, is well given, for I defy anyone at first to feel certain that a small dog is not yelping somewhere in the forest. The toucar has also the same peculiarity.

SOCIAL SCIENCE.

WANTON WASTE.

The advocates of socialism and paternalism as essential principles of sound government, find no little support in the incurable folly with which mankind in the mass, if unrestrained by law, squander the means of subsistence provided for them by nature. We say mankind in the mass, but it is not by the action of the whole body as a unit that this criminal waste is perpetrated ; it is by the individual dealing with what belongs to the community. Individualism, when acting within the limit of its own belongings, is commonly not distinguished by prodigality. Its habit is rather to save and hoard, and to measure its indulgence by the probable extent of the supply. But give it access to common property and it takes no thought either for the morrow or for any other needs or rights but its own. It is difficult to account for this propensity, otherwise than simply to call it one of the infirmities of our nature and let it go at that. The fact, however, is indisputable, and receives constant illustration in the conduct of life. Give a man a loaf of bread and he will ordinarily be sparing of it if he knows that no more is to be had within a given time. Why is it that fifty men with a barrel of flour at their disposal cannot be equally provident and calculating is the question on which, as before intimated, the science of government hinges to a very considerable extent.

Each of the fifty men will help himself as freely, and scatter to the winds what he does not carry away, as recklessly as if the barrel had no bottom, or were miraculously renewed. In like manner, a community, every member of which would husband a cord of wood with the most prudent care if it were bought at a round price, will hack, burn, girdle, and indiscriminately destroy a forest which money cannot replace, when the day comes in which its loss is fully realised. The same wastefulness and the same indifference to future needs extends through all branches of industry where the material is afforded by nature, and each consumer has not his own portion to pay for across a counter.

The man who helps himself wastefully and destructively from the common stock is not, perhaps, wholly under the sway of selfishness. The cause is often, it would rather appear, a defect in the organ of calculation. The mathematical faculty, the power of comparing one large aggregate with another, of estimating a national supply by its proportion to the national requirement, is not, after all, so common as might be supposed. In fact, only those have it in good working order who are accustomed more or less to speculative reason, and even they possess it rather in the abstract than in the concrete. If all the ready-made clothing in London were gathered into one vast salesroom and displayed with an eye to numerical effect, even an expert statistician might be pardoned for imagining for the moment that he could appropriate a dozen suits and burst the seams of a dozen more in trying them on, without any appreciable invasion of the rights of his fellow Londoners. And it cannot fairly be assumed in regard to any man who is making a wasteful inroad upon any of our natural resources, seemingly without limit to their abundance, that he is saying to himself : " After me the deluge," or intending, or consciously committing any attack whatever upon the rights of his neighbour and the general public. He simply has not figured the thing out, and very likely is not competent to do so.

This is the main reason why exhortation and admonition on these points, addressed by a public journal to the individual reader, usually fail of any useful effect. Men preaching will not influence a man's conduct against his own present ease and convenience, unless it is supported by the evidence of his own senses. And this support it does not receive when he is only one of a thousand or ten thousand people who are denuding a mountain range of its forests, or one out of a million agriculturists who are exhausting a fertile soil by unthrifty farming.

How much the law can do towards restraining the greed or connecting the misconceptions of individuals in matters this kind, is one of the difficult problems of the age. The socialist, for example, thinks he can do everything. His doctrine would have to be carried very far before mistaken practices in agriculture, or errors in the conduct of men's personal affairs could be effectually reached. A man was crushed by a railway train in one of our suburbs not long ago, having attempted to climb into a carriage after the train had begun to move ; and the comment was made that the company would now see the necessity of building a fence which would prevent belated passengers from following the train, as the law should long before have compelled it to do. In other words, the law, acting through the company, ought to forcibly restrain people from the commission of suicide.

There should also, on this principle, be a law to forbid any further attempts at ascending the Alps ; for there is no practical good to be attained by such excursions, and an unusually large number of lives were lost in the past season, and others in the present season, in these rash and unprofitable ventures. Such a law could have saved the life of that Brazilian tourist, who, the other day, fell into the crater of Vesuvius, having previously been warned without effect of the danger he encountered. Good advice in such cases is invariably thrown away ; and it appears to be equally useless where the question is not as to the immediate saving of life, but relates to the provident use and conservation of those natural resources which are essential to life under civilised conditions.

But a doctrine need not be rejected because it is logically capable of extreme results. In the science of government, as in all other matters, a theory may be judicious and practical in some, but not in all of its applications. And it may seem, therefore, to a rational observer that while no statute can make men careful of health, wealth, and life in the degree which is to be desired, there are some directions in which they may be wisely restrained. Where the case is clearly one of public concern, society cannot go wrong in protecting itself against itself by hindering the wanton waste of the gifts of nature.

Our Monthly Edition.

SCIENCE SIFTINGS may now be obtained in Monthly Parts, bound in buff wrappers. Price 6d., or post free, 8d., of any Newsagent ; W. H. SMITH & SON'S bookstalls ; or of the Publisher, 78, Fleet-street, E.C.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

THE SALT OF THE SEA.

The sea is not of uniform saltness at all depths, for the saltness generally increases with its depth. The investigations of the "Challenger" show that as a rule the saltness of the sea decreases from the surface to a depth of from 800 to 1,000 fathoms, and after that increases until the bottom is reached. This can not be taken as a fixed rule, however, as different seas are subject to different conditions. These variations depend upon the currents of fresh water which are poured into the sea from rivers. Thus the Caspian Sea contains 11 pounds of salt to every ton of water, and the Red Sea 93 pounds. In the Mediterranean the saltness increases with the depth, while in Baffin's Bay the surface water and deep water are the same. It has been calculated that if all the salt were extracted from the sea and spread over the surface of the land it would form a layer 30 feet deep.

HELPFUL HINTS.

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

Dilettantism—Political Economy.

Harold Nye.—(1) Dilettantism is, as Carlyle himself put it, "a kind of amateur search for truth." It is the desultory, finical, or affected pursuit of literature, science, or art by a mere superficial dabbler. Lowell said (New Princeton Review I.160) "the main characteristic of the dilettante is that sort of impartiality that springs from inertia of mind, admirable for observation, incapable of turning it to practical account. The derivation of this word is from the Latin *delectare*, delight. (2) We cannot name a more recent, and, at the same time, authoritative exponent of political economy than W. S. Jevons. The science of what you call mathematic-economies is now, we believe, generally accepted by those who understand it: but frequently not by those—constituting the great majority of people—who do not understand it. (3) For articles on phrenology by a professor of the art, see Science Siftings, Vol. I., pp. 11, 26, 41, 56, 72, 90, 105, 124, 140, 156, 173, 189.

Midges.

Gen. A. Macdonald.—We believe diluted ammonia to be one of the most soothing applications to one's skin, when irritated by the attentions of midges. There is perhaps no clear line of distinction to be drawn between midges and mosquitoes. Presumedly the attacks of both of these pests can be warded off by similar means. But we assent to your observation, that the reputed cures are apt to be the worse of two evils. It is notorious that a fortune is awaiting the discoverer of any preventive of the onslaughts of those midges, of a larger growth—mosquitoes. And no one will grudge the reward to such a benefactor of mankind. We have experimented with a nauseating compound, that proved to be of some little service, but of which the recipe has been mislaid. Will be given in next issue if it can be found. Meantime while fishing, etc., why not veil the face. A convenient plan, when appearances go for nothing, is to wear a pair of "goggles," or spectacles fitted with plain glasses, in short cylinders of wire gauze that fit round the eyes. The veil can be attached to the wire gauze of the goggles, and to the cap, and tied behind.

Miscellaneous.

W. Turner.—(1) Carbonic acid gas is, in the ordinary sense of the word, a non-conductor of electricity. It is capable, however, of conveying what is called a convective current, in which little charges of electricity are conveyed through non-conductive space by the ever-moving particles of the gas. (2) Carbonic acid gas, in common with all other known substances, is permeable by the magnetic force.

A Regular Reader.—What is referred to in the answer to query 164 is, we take it, a contraction of the muscles of the abdomen, by which one can readily prove that the act of expiration is assisted.

W. H. Neal.—Dr. Arnott's method of treatment, in cases of stuttering, consists in impressing the patient with confidence in his own power of overcoming the difficulty by giving careful and persevering attention to the clear steady articulation of the different letters, of which the consonants V and F are commonly most troublesome.

R. W. Green, Junr.—We regret that we must refer you to books on natural history, for we cannot possibly undertake to receive the specimens at this office for naming. Undoubtedly the best method for preserving worms, etc., is to cork up in a bottle filled with methylated spirits of wine. Narrow bottles made of thin clear glass would be most suitable. Will reply to your other question next week.

J. Hardman.—A solution of ammonia in water is to be considered a chemical compound, rather than a mechanical mixture. The heat that is evolved in the solution of this gas is indicative of chemical reaction

Mercury.—We are indebted to you for your letter. What you say is, in the main, strictly correct. The mean distance from Mars to the sun is, however, 140,000,000, not 141,000,000, as you put it. Owing to the ellipticity of the terrestrial and martial orbits, the distance from the earth to Mars when in opposition may vary from 33,500,000 to 62,500,000. The diameters of Phobos and Deimos have not, we believe, been very satisfactorily determined. The exact period of revolution of Phobos is 7 hours 39 min. 13·996 sec.

E. R. London.—The number of galvanic cells required to work an electric glow lamp depends upon the resistance of the lamp, and the voltage required. Ask the optician from whom you have bought the 5 candle-power lamps what voltage they require, and what is their resistance, and we will then be pleased to inform you what battery power is necessary. A bichromate battery will no doubt be most suitable for your purpose. One of the best elementary text books of electricity and magnetism is "*Electricity*," by Ferguson, price 3s. 6d. see below.

Chine.—(1) Bridges are nearly always tested, but not with dangerous loads. The testing is simply for the amount of deflection of the bridge by a moderately heavy load, from which deflection it is possible to draw very accurate conclusions, as to what would be the effect of a heavier strain. (2) We recommend Ferguson's "*Electricity*," price 3s. 6d., see below.

Reader (Walsall).—For chemical arithmetic, see Adriance's "*Laboratory Calculations*," see also reply to G. Sheal, below.

G. Sheal.—Six of the best books are Ferguson's, Fleming's, and Atkinson's "*Electricity*," prices respectively 3s. 6d., 4s., and 7s. 6d. Swinburne's "*Electrical Units*," 1s. 6d., Niaudet's "*Electric Batteries*," 10s. 6d., and Jenkin's "*Electricity and Magnetism*," 3s. 6d. Any of the books can be had from Mr. George Airy, 42, Gray's Inn-road.

George T. Oliver.—We regret having been unable to find any book giving an account of "the lost arts."

S. J. England.—Sea water is compressed by about ·000044 of its bulk by a weight equal to one atmosphere; but the amount of compression per atmosphere diminishes as the pressure increases. At a depth of one mile sea water is, owing to the superincumbent pressure, of about $\frac{1}{130}$ greater density than at the surface.

Operative Chemist.—"Soda" for "silver" was a very palpable *misprint* on p. 228 of No. 43. Had your chemical been quite equal to your hypercritical ability, you might also have noticed that "sulphite" was misprinted 'sulphate."

*** Owing to the great pressure on our space this week many replies to correspondents are again held over.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)
The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers

PRIZES FOR THE WEEK ENDING AUGUST 27th.

The senders of the first twelve letters, opened by us on Monday, August 29th containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, August 29th, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 29th inst. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page i. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors or the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter.

*** The Coupon will be found on page i.

SCIENCE SIFTINGS
CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*, 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, SEPTEMBER 3, 1892.

SCIENCE NEWS AND NOTES.

"Charms strike the sight; but merit wins the soul."
—POPE.

Our Change of Title

has not yet been decided upon, although we have now received some very desirable suggestions. However, this is not a matter that can be settled without very mature consideration, and as the title cannot be altered until the commencement of our third volume (seven weeks from now), we hope our readers will in the meantime send us any appropriate ideas that may occur to them. One carping correspondent writes:—"As you seem to know just what you want for a new title to your paper, and no one else does, why trouble them (*Sic*)?" We have too much confidence in the good nature of our readers and in the friendly feeling existing between them and ourselves to believe that we are troubling them; and although we admit knowing exactly what we require, we must also confess to finding a difficulty in framing our knowledge into a really happy shape. This is why we ask the assistance of our readers, and as we offer a guinea for a name that suits our taste, we think we have every right to be as fastidious as we please. Those who have not yet made an effort to earn the guinea—those who have may try again—should write their proposition for the new name on a post card and mail it to us. The word "science," however, as we have already intimated, should not be introduced into the suggestion.

The Electric Belt Quacks

have had a very uneasy time since the appearance of the last issue of SCIENCE SIFTINGS. Their trade must have fallen considerably, since every unhappy owner of a so-called electric belt is hastening to dispose of his useless possession, The following great reductions in price will show what the possessors think of their property:

Harness' electropathic belt, waist 35 in. Cost 60s.; accept 25s. Miss Heyn, Hounslow.

Harness's electropathic belt and spine band, *not once used*. Cost 8 guineas; what offers? Address Manachi, 27, Park-way, Liverpool.

Harness's gentleman's electric belt, large size. Cost 63s.; nearly new; sell 21s. (Scotland.)—27ION.

Harness's electropathic belt, in box, for lady. Cost £3; worn twice; medium size; price £1. Mrs. Elliot, Glenview, Barrick-hill, Newport, Mon.

[Our issue of August 6, in which our first article about Mr. Harness's institution appeared, may still be had by sending the necessary stamps to the publisher, or of any newsagent.]

The above advertisements are a selection of numerous that are appearing in the columns of our esteemed contemporary *The Exchange and Mart*. We congratulate ourselves on having the entire medical faculty with us in the step we have taken in exposing these pretentious belts. Many medical men have personally congratulated us on our action, and others are studiously collecting evidence of a most vital nature that will ultimately appear in SCIENCE SIFTINGS. We trust that our readers will give us a helping hand in the good work we have undertaken *pro bono publico*. This they can do by giving us full information about cases where suffering has resulted from a visit to Mr. Harness's Oxford-street Institute. Names and addresses must be furnished, but will not be published unless permission be given.

Can the Influence of the Mind Produce Disease?

and can the influence of the mind cure or remove disease? These are two interesting questions asked by Dr. Wm. Dale in a paper that has just been published. The efficacy of strong emotion in producing, or in helping to produce, certain abnormal conditions of the human system is well recognised by the medical faculty; and it is also acknowledged that a depressed physical and mental condition renders the bodily organs more susceptible to the influence of some poison, such as that of the specific fevers, and when the inseparable connection between mind and body and the profound alterations which fear or joy bring about in, for example, secretory organs, are taken into account, it is not surprising that violent emotion should, as it were, open the gate to allow the admission of sundry poisonous influences. It is an interesting question how much of the general—but by no means invariable—immunity which medical men enjoy from infectious disease is due to the calmness and unconcern with which they regard such diseases in relation to themselves. This is due, according to the *Lancet*, to the fact that they forget to be afraid, and so are clothed with an invisible and often an invulnerable cloak.

The Power of Mind over Matter

is illustrated by Dr. Dale by many instances where patients have wrought their own cure with a mere exercise of will. This has been specially notable in the case of hydrophobia patients. Others, however, have given themselves the same complaint by an exercise of fancy. One example of the power of the will over the bodily functions is recorded of a man who could stop the motion of his heart when he pleased. A young lady, in other respects healthy, had gastric nerves so wayward that they would permit only a small amount of food to remain on the stomach. This condition produced great debility and inconvenience. Her physician told her that she might by a strong mental effort free herself from the ailment. She tried her best, but failed. It became

apparent that she did not possess sufficient will-power for the task. The physician, therefore, decided to assist the will by inducing strong emotion with respect to the ailment, and this he effected in the following manner :—Going to the future husband of the lady, he urged him to inform her that their union could not take place until she was cured. The time fixed for the marriage was close at hand, and the shock of such news had an immediately beneficial effect. Her gastric nervcs began to resume their normal functions from the moment of that interview. Another woman who suffered from "hysterical paralysis" of the lower limbs regained her wonted activity through the fright occasioned by the threat of a drunken man to kiss her. While a man who was impressed with the belief that he had died from some liver complaint, speedily regained both life and perfect health on the approach of the dissecting knife.

Excessive Joy as well as Excessive Grief

may even cause death. Wives on receiving their husbands back safe and sound, who had been reported as certainly lost, mothers on embracing their sons who were thought to be dead, poets on coming to sudden honour and fame, and prisoners on being pardoned or suddenly released, have died from the shock of sudden joy. Rheumatism has been produced by fright, and this ofttimes seems to be the only exciting cause ; and gout is proverbially dependent on mental influences; fretting, worry, domestic vexation, joy, anger, terror, and excessive mental strain are all exciting causes of this disease. Joy, grief, or disappointment will, according to many writers, occasion fever. In short,

> "The safest way to health, say what you will,
> Is never to suppose we shall be ill ;
> Most of those ills we poor mortals know
> From doctors and imagination flow."

The above lines from Churchill contains the secret of a successful struggle with life. In the matter of health, as in everything else, a complete belief in oneself is more than half the battle.

The Sanitation of Houses

has just been the subject of attention by our energetic contemporary, the *Lancet*, which has organised a special commission to inquire into the best methods for protecting the public against insanitary homes, and what improvements in the law and practice of house-letting are desirable, and should be attempted. It too frequently happens, as our contemporary points out, that a tenant signs the agreement or lease of a house without the slightest inquiry having been made as to the drains, and such essential points as the ventilation and proper jointing of the house drain and the disconnection of waste-pipes are completely overlooked. He is not seldom imbued with the idea that "good drainage" is a variable and elastic term, and that so long as the drains are not obtrusively offensive, he had better leave the matter alone. The prevalent notion that even in the minds of sanitarians uncertainty still lingers as to what points should be kept in view to render a house well drained, accounts largely, we feel sure, for the disinclination, on the one hand, of the landlord to consider carefully the drainage of his houses, and, on the other hand, for the apathy and indifference of the tenant, who usually remains passive until roused to a sense of his danger by an outbreak of illness in his home.

Many Valuable Suggestions

are advanced by the commission and the people whom it has interviewed with a view to securing tenants against drainage defects. The following are some of these sensible proposals :—(*a*) That there should be hung in the house a plan of the drainage; (*b*) that the landlord should produce a builder's certificate ; (*c*) that the local authority should make periodical inspections of all houses in their district, and that certificates should be granted with date of last inspection, if found in good order ; (*d*) that the landlord should have the option of asking the local authority to make a survey of his house upon payment of a fee, that the local authority may advise what (if any) alterations should be carried out, and that, if these be done to their satisfaction, a certificate should be granted ; (*e*) that plans of the drainage of each house should be kept by the local authority, which should be open to inspection on payment of a fee ; (*f*) that the "sanitary history" of houses should be preserved by the local authority, so that the nature of the infectious diseases which have occurred in the house could be known. It is also extremely desirable that careless laying of drains be made a punishable offence, and that owners letting insanitary houses be rendered liable to be sued for damages. We trust to see all or, anyhow, part of these vital suggestions adopted by every local authority. Such a course would do more towards stamping out disease than anything in the way of health legislation has yet done.

The Practice of Covering Floors with Carpets

is not without its disadvantages, even its dangers. The particles which give substance to the pure search light of a sunbeam as it penetrates the window pane are of the most varied character. Harmless as are very many of them, there are also many more possessed of true disease generating energy and capable of almost unlimited multiplication. Anyone can see, therefore, how, when sheltered in dusty woollen hangings, chair upholstery, and carpets, they render these articles veritable harbours of disease. The less we have of such the better, especially in bedrooms. Some practical deductions naturally suggest themselves. As to curtains and carpets, it is but rational that they should, as a rule, consist of the smoother and harder fabrics which will bear thorough and frequent brushing. If thicker floorcloths and rugs be used, they should be such in size and arrangement that they can be readily taken up and beaten. It is but part of the same argument to say that as much of the floor as possible should be either varnished or laid with oilcloth, so as to allow of frequent cleansing. Cane and leather, for a like reason, are incomparably superior to the richest upholstery when we come to speak of general furniture. Some, perhaps, may imagine that in making these observations we treat this matter too much as a hobby. We have only to revert, however, to one circumstance, mentioned by a writer in the *Lancet*, in order to convince any such of their real and practical significance, and that is the actual presence of infectious disease. When this appears all forms of cumbrous comfort in the apartment must give place not merely to a freer and simpler arrangement, but even to bare, sunlit, and airy desolation.

The Boiling of Milk before Consumption

has been frequently advocated in these columns, since milk is undoubtedly one of the surest channels by which infectious diseases are diffused. The advice has been met, however, with the objection that the boiling process deprives the fluid of its nutrient properties, and also its digestibility. As the result of some most interesting experiments we are glad to record that Dr. Chamouin has been able to show that milk after boiling is not only more easily digested, but has actually a higher nutrient value than in the crude state. Our authority fed a number of kittens on boiled milk, and an equal number of kittens on the same milk as it came

direct from the cow or the goat. Those of the former category he found to be twice again as fat and healthy as those of the latter. A kitten, however, which was left to its mother was the fattest and healthiest of all, though this was due to the assiduous attention which the maternal instinct supplied, and which the experimenter pleasantly admits is beyond the resources of the laboratory. Following up his demonstration, Dr. Chamouin examined the statistics officially issued by the Town Council of Paris as to infantile mortality, and finding that the chief cause of this was intestinal ailments, he prosecuted his researches so as to include a comparison between those infants that had been fed on boiled, and those that had been fed on unboiled milk. He found a remarkable diminution in the death-rate of the former. His investigation also showed that thousands of infants are annually safeguarded from intestinal disease and death by boiling the milk on which they feed.

A New Method of Producing Artificial Respiration

has been discovered by Dr. Laborde, of Paris. It consists in drawing the tongue well out of the previously opened mouth and then imparting to that organ energetic and rhythmic backward and forward movements. This manœuvre has the effect of stimulating the respiratory reflex through the traction on the tongue and the excitation of its basal portion. The *modus operandi* is very simple. A spoon, the handle of a knife, or any such instrument is utilised for the double purpose of keeping the jaws apart and pressing on the base of the tongue. The tongue is then seized between the finger and thumb—which, to avoid slipping, are enveloped in a handkerchief—and pulled forcibly forwards out of the mouth. The organ is then subjected to the rhythmic to-and-fro movements, eighteen to the minute, until success 'crown's the operator's efforts. Whilst advising recourse to the methods usually employed, Dr. Laborde believes, as the result of having saved two lives by means of it, that his own proceeding is the most effectual, and that it will often succeed even when all hope is apparently fled.

The Depopulatlon of France

is now going on so rapidly that the deaths exceed the births by nearly 40,000 in a single year, and French science is laying itself out to deal which the peculiar problem. Increasing the birth-rate having proved impracticable, the present hope is to diminish the death-rate. At a recent meeting of the new Society for the Protection of Children, Dr. Richard referred to the fact that only eight years ago he was laughed at for predicting that the population would become stationary before the end of the century, and stated that 250,000 infants die yearly, of whom at least 100,000 could be saved by intelligent care. Stringent laws have been already passed to aid in preventing this great waste of life. It is now illegal for any person to give children under one year of age any solid food except on medical advice, and nurses are forbidden to use nursing bottles having rubber tubes. Efforts are being made also to induce Parisian mothers to nurse their own infants.

The Spread of Cholera

has again brought forward the question of the utility of tobacco smoking as a disinfectant. A large number of investigations have been made by Dr. Tassinari on the influence of tobacco smoke on the germs of cholera, anthrax, and pneumonia. His method of research was to line the interior of hollow balls with gelatine containing the germs of the diseases named; tobacco smoke was then passed through these globes for from ten to thirty minutes. The surprising fact was then established that at the expiration of that time the bacilli of true Asiatic cholera and of pneumonia were completely destroyed, whatever the kind of tobacco employed for the purpose. The gelatine was absolutely sterilised by the tobacco smoke. The anthrax bacillus was more resistant, however, while the bacillus of typhoid was scarcely acted on at all.

The Purity of Wine

is a very debateable question, and as we have recently had the advantage of discussing the matter with an expert, we placed the information gleaned before our readers for what it may be worth. It is, of course, questionable whether any wine containing over 13 per cent. of alcohol is not "fortified" or "doctored." In strong ports and sherries, from 16 to 25 per cent. of alcohol is used; in clarets, hocks, or other light wines, probably not more than 7 per cent. Italian wine is made of pure grape juice, and, consequently, is dependent upon the quantity and quality of the grapes of which it is composed.

German, French, and Spanish Wines,

on the contrary, are always "doctored." If, therefore, the crop is insufficient in quantity, other wine is added; and if it is wanting in proper qualities, chemical ingredients are mixed with it until the decoction acquires the desired body and taste. For this reason the Italian wine is infinitely the more wholesome beverage, and ought to be more sought after. There is no doubt that greater care in its preparation would greatly improve its character, but the Italian peasant is obstinately conservative. He will go on using the same vats from year to year without ever thoroughly cleansing them, and will often mix all sorts of grapes together. The time during which the wine is left to ferment exercises also a great influence on its quality, and here again the peasant proprietor, with his small cellarage limits and his restricted capital, is at a disadvantage. He cannot afford to keep his wine long. He must turn it over and make it into cash. Of all Italian brands, Chianti is most in request, and its superiority is due in a great measure to the quality of the grapes which grow on the spurs of the Apennines, where there is a great deal of sun and very little rain. It is not likely that the making of wine in the French sense will ever take root in Italy. The Italian has a great dread of what he calls "vino maliziato," or falsified wine—literally, wine that has been made malicious. Genuine wine he calls "sincere."

Ballooning

becomes every year more of a science, although unfortunately it often falls into disrepute through the practices of the unscientific. As our contemporary the *Optician and Photographic Trades Review* has pointed out, the accident to the Late Captain Dale's vessel might have been averted if it had been constructed which several gas-tight compartments, instead of having only one reservoir for the gas on which its buoyancy depended. Another experiment has also been made by Mr. C. G. Spencer with a view to prove that Captain Dale's death was due to negligence. It is said that had Dale cut the neck line of his balloon it would have formed a parachute, and descended in safety. Mr. Spencer sent up a balloon, with a weight equal to three persons in the car. It had one of its seams opened, and a sand bag attached by a fuse that burnt through at a height of 3,000 feet, and the weight of the bag then ripped the balloon from top to bottom, the neck line having been cut before starting. It acted as expected, forming a perfect parachute, and, coming down with the utmost gentleness.

GLEANINGS OF THE GLOBE.

TELESCOPES were first made by Jansen, 1590.

WATER pipes of lead were first made in 1236.

THE folding envelope was first used in 1839.

COAL was first used in England as fuel in 1350.

TUNGSTEN is the only metal of which no well-marked basic oxide has yet been discovered.

THE temperature of the hydrogen flame in air is about 3,600° F.; in oxygen, over 5,000° F.

A CHEMIST advises that tinned fruit be opened an hour or two before it is used. It is far richer after the oxygen of the air has been restored to it.

BUTTER or cans of milk may be kept perfectly cold by being wrapped in a cloth and set in a deep dish containing a little water, where air is circulating.

SOME ingenious individual has determined, by some calculation best known to himself, that every two days' fog puts 25,000 people on a bed of sickness in London.

SIR JAMES HALL succeeded in converting limestone under great pressure into a kind of marble, and even fused it, and found that it then acted vigorously on other rocks.

THE aborigines of the Andaman Islands, a curious and even unique people, are said to be fast disappearing. All of them on two of the islands are dead, and only a few are left on a third.

PROFESSOR VERNON BOYS succeeded some time since, in making a thread or film of quartz so fine, that under the microscope, a spider's web appeared in comparison to it like a ship's cable.

THERE is a curious snake *(hydraci yeti)* in South Africa that lives wholly upon birds' eggs. It has no teeth or signs of teeth in the mouth, the whole dental array being located in the stomach.

M. FOREL has calculated that the quantity of heat accumulated in the Lake of Geneva during the summer is equivalent to that which would be given out by the burning of 51,000,000 tons of coal.

FLUIDS which do not adhere, or are not attracted upward by the sides of a vessel, sink around the brim and rise in the centre. Thus mercury in a glass forms a convex surface, while water forms a concave.

SEALS, when basking, place one of their number on guard to give the alarm in case of danger. The signal is a quick clap of the flippers on a rock. Wild rabbits signal with their forepaws, and have regular signals and calls.

CAPTAIN STROMBERG was crossing the Atlantic on the Norwegian barque "Iona," and was 100 miles from land, when a pigeon flew on board. The bird had a silver ring on one of its legs, with the inscription, "R. S., 1892."

A NEW arrangement for the detection of fire damp consists in pumping air into a testing-room and testing it with a Bunsen burner. If the air contains a dangerous quantity of fire damp it ignites, and, moving a valve, sounds a gong of warning.

THE belief that spiders are good weather prophets is as old as the time of Pliny, who stated that when a river was about to rise the spiders in the neighbourhood built their webs at a greater elevation. There does not appear, however, to be much ground for the theory.

DRS. BRIEGER and Wassenman have made a report in regard to the results of their experiments in inoculating animals against cholera. They claim they injected cholera bacilli into guinea pigs until the animals were practically in a state of immunity from the disease.

CABBAGE has always been said to be a cure for intoxication. The Egyptians ate boiled cabbages before their other food, if they intended to drink wine after dinner, and some of the remedies sold as a preventive of intoxication on the Continent contain cabbage seed.

STRAY dogs in Paris are slaughtered immediately they are captured by the police, and their skins are tanned. Instead of taking seven or eight months to transform the skin into leather, as is the case by the ordinary system, electricity does the work in three or four days. The leather so tanned, moreover, it is asserted, is much better than that manufactured by the ordinary process.

A NEW use has been found for diamonds, in assisting marksmen in their shooting. The cut stones are fixed in the front and back sights, and it is said that they enable the gunner to take a quick and correct aim, even when the light is bad. The brilliants are so fitted that as soon as the gun is brought to the shoulder, the rays in the gems assist alignment, and the eye takes aim without the least hesitation.

M. BERTHELOT has traced the derivation of the word bronze to the city of Brundusium, now Brindisi, where was the seat of certain manufactures in which the alloy was employed. A Latin manuscript of the age of Charlemagne, found in the library of the chapter of the Canons of Luynes, gives a receipt for the "composition of Brindisi"—copper, two parts; lead, one part; tin, one part.

THE extent of the influence a lake may exercise upon climate is illustrated by the statement of M. Forel, that the quantity of heat accumulated in Lake Leman during the summer is equivalent to that which would be given out by the burning of fifty-one million tons of coal. A railroad train carrying this coal would be eighteen thousand kilometres long, or nearly the length of the earth's meridian from pole to pole.

DR. JAMES LEICESTER gives a probable explanation of the change of colour that shrimps and lobsters undergo upon boiling. Concentrated hydrochloric acid in which a few shrimps have been digested acquires a bright purple colour resembling litmus solution. This colour goes after three or four days, and the solution becomes of a dirty brown colour. The colouration is not caused by any iodine compound, but is probably of an organic nature. Acetic acid and caustic potash give slightly yellow solutions.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not satisfactorily replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 44.

187.—What causes spontaneous combustion to take place in coal or cotton, etc.?

Spontaneous combustion generally takes place when oxidisable substances are stored in large quantities subject to limited access of air. Oily rags or cotton waste are particularly liable to spontaneous combustion, because most oils readily enter into combination with the atmospheric oxygen. "Sulphury" coal containing pyrites is also very rapidly oxidised, and a number of other combustible materials are much more apt to combine with oxygen at ordinary temperatures than is commonly supposed. When the air has free access to such oxidising, that is to say, slowly burning substances, the heat that is produced by the gradual combustion is carried away. But when the access of air is just sufficient to maintain the chemical action, it is likely to be inadequate to carry off the heat thereby liberated, and this heat may accumulate, with continual increase in the energy of the combustion, until eventually the whole mass of material bursts into flame.

188.—What causes the singing noise made when a kettle is nearly boiling?

The noise is caused by minute bubbles. When the water is first warmed such bubbles are caused by the liberation of dissolved air and other gases, but these break at the surface and pass away comparatively quietly. As the temperature rises higher little bubbles of steam form at the bottom of of the kettle. These bubbles become detached from the heated metal and quickly ascend through the water, but as this has not yet reached the temperature of steam the bubbles are condensed by it. They collapse with a sharp click that may be compared to the click of a water hammer. In fact the sound is due to the falling together of the water where such bubbles of steam condense. When the whole of the water has reached the temperature of 100° C. condensation no longer takes place; the bubbles of steam reach the surface and burst there, or in other words ebullition commences.

189.—Why do colours fade when exposed to sunlight?

Many pigments are bleached by oxidation, that is to say by the chemical union of the colouring matter with the oxygen of the air. This union is brought about by the action of light or actinism which when absorbed by such bodies increases the activity of motion of their minutest parts. Violent disturbance of the chemical atoms increases the facility with which combination takes place between the colouring matter and oxygen. A very similar reaction is well known to photographers, for it is the fact that light promotes oxidation in bitumen that is the basis of the well-known photo-engraving process.

190.—Why is fruit more wholesome in the morning than in the evening?

Fruit is not considered to be unwholesome in the evening, but authorities are agreed in recommending its use in the earlier part of the day. It is of comparatively little value as nourishment by comparison with other forms of vegetable food, but, even apart from this, the water that it contains in such large quantity is of some value as being an essential part of the diet conveyed in an agreeable and quite unexceptional manner. The small amount and the ready digestibility of the nutritive matter contained in fruit renders it one of those articles which is peculiarly adapted for use first thing in the morning. More substantial demands upon the powers of the digestive system may with advantage be deferred until later. As for the suggestion, which has become proverbial, and is, no doubt, based upon experience, that fruit is most beneficial if taken immediately upon rising, one may compare it, by reason of the large quantity of water which fruit contains, as just stated, with the other well-known maxim of the dietetists, that a glass of water should be drunk the first thing in the morning, presumedly with the object of flushing and cleansing those channels or pores which may have become clogged as the result of a period of inaction.

191.—How is copper prepared from its ores?

The principle ores of copper that are smelted in this country are a sulphide (copper pyrites) and a carbonate (malachite). These are roasted, and next oxidised in a series of furnaces in which a fusible slag is admixed with them and complex chemical reactions take place. The product of these oxidising processes, conducted at a very high temperature, is known as blister copper. This is further refined by additional oxidation, and is finally submitted to the process of polling, which is, perhaps, from a popular point of view, the most interesting feature in the manufacture of copper. Polling is necessitated by the fact that the melted copper contains oxygen gas in solution, and that, even in very small quantities, this "occluded" oxygen is productive of brittleness. To remove it, pieces of anthracite coal are thrown on to the surface of the molten copper, and the metal is also stirred with rods of green wood. These combustible materials abstract the oxygen from the copper, and throw it off in the form of carbonic acid gas.

192.—What is the difference between static and galvanic electricity?

Static electricity means an electric charge that is fixed with respect to surrounding objects. The electric charge is probably itself to be regarded as a condition of strain in an immaterial fluid permeating all bodies and all space. The strain may be a condition of pressure or of tension corresponding to what is called a "positive" or a "negative" charge. When as a matter of experiment an electric charge is set into rapid motion effects are produced resembling those of a galvanic current. It is, therefore, argued that what constitutes a galvanic current is probably a condition of electric charge travelling continuously in one direction, and not, as was formerly imagined two opposite kinds of charges travelling simultaneously in opposite directions along the path of the current.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

199.—What is the explanation of the change of seasons?
200.—Does water, in nature, ever run up hill?
201.—Is colour photography possible?

202.—Is it possible to register the pulse beats by mechanical means ?
203.—What is the cause of an earthquake ?
204.—Where does the light go to when a candle is blown out ?

A CHARGE REFUTED.

Our accuracy in scientific matters has never been seriously impeached ; it has, however, been adversely discussed in the course of a feeble attack upon us by a respectable, but, perhaps, somewhat murky contemporary, the *Electrical Review*. Now, it is impossible, or, rather, we consider it highly undesirable, that the editor of a popular periodical should dock, in conformity with his own or with any conventional scientific views, those liberal speculations by which our most advanced thinkers seek, not merely to recount the past achievements, but to anticipate the future extensions of physical and metaphysical hypotheses.

Science Siftings is filled with original matter, contributed by a number of brilliant writers and skilled experts. The paper is not committed to any hypothesis, nor to the opinions of any scientist, however eminent. So the Editor intends that it shall remain.

Encouraged by the steady increase of our circulation, we know that the public is with us ; and we will continue to seize thought and imagination by the forelock—to *materialise* and simplify the most recondite philosophical theorics—and to mention or discuss the newest, even when they appear to be the less probable, of such conjectures as those which, in the past history of science, have proved facts to be so often first descried by imagination. We will persist in looking at both, or all, sides of every question, notwithstanding the criticisms and ill-concealed chagrin of a stagnating technical organ.

Technical ignorance has been charged to us by the *Electrical Review*. The staff of that journal cannot assent to the supposition that we expressed on p. 217 "that an infinitesimal current must have actually passed *through* Mr. Gatchouse's leg or arm." But, while our views have been expressed in the last paragraph as to the desirability of some degree of freedom from the restraints of pure technology, it must be asserted distinctly that the independence we lay claim to is wisely used, and not ignorantly indulged.

When technical or conventional knowledge is requisite, we shall not be found wanting ; and it must be understood, for instance, that, in the particular case just referred to, our electrical contemporary was distinctly in the wrong. We pointed this out a couple of weeks ago (p. 239), and, in a friendly manner, we advised our contemporary to readjust its own opinions in becoming silence. If this advice is being taken—but it would be premature to congratulate our astute contemporary, for perhaps the staff is engaged in formulating a reply.

VOLUME I. OF "SCIENCE SIFTINGS"

CAN BE HAD.

Bound in Cloth and Gold, 3s. 6d. Postage 6d. extra.

Or from Messrs. W. H. Smith & Son,

and through any Newsagent.

NOAH'S ARK JUST FOUND.

The Rev. John Joseph Nouri, D.D., LL.D., the Chaldean archdeacon of Babylon and Jerusalem, has arrived at San Francisco, and has told an interviewer that he has seen Noah's ark. We must, however, in no way be taken to vouch for the remarkable statements we set forth, which we publish only because we believe they have been uttered in perfectly good faith by the reverend narrator. As he recounted, he has travelled, preaching and exploring in various lands, 250,000 miles. He set out from his home in Jerusalem seven years ago, and it will be five years yet, he says, before be gets back. In five years he will travel 150,000 miles more, making a total in twelve years of 400,000 miles, or a distance of more than fifteen times round the earth. In addition to the office held by him, as indicated by his degrees, he is Pontifical Delegate-general of Nedabor and ex-Grand Secretary of the Metropolitan Archdiocese of Persia and India. He was educated at Babylon, previous to which he spent much of his time at Jerusalem and Bagdad. Therefore, we may take for granted that a man of his high attainments does not draw on his imagination.

Two of the things he told about were his explorations in the Mountains of the Moon, in the east of Central Africa, while trying to find the source of the Nile, in which he found gold so plentiful that the mountains were fairly ribbed with it, and boulders along the way sparkled with the yellow metal, and the other was the discovery of the sources of the Tigris and Euphrates in Mount Ararat in Armenia, and a tremendous vessel on top of one horn of Mount Ararat, which he regards as the veritable ark of Noah.

"In this journey to the undiscovered and hitherto unexplored Mountains of the Moon," said he, "I set out from Alexandria and penetrated 2,000 miles in the interior. I went by way of Cairo, thence down to Codar, and thence to Khartoum in the Valley of the Nile. From there I proceeded to Timbuctoo, in the south of the great Sahara. Timbuctoo now has between 60,000 and 70,000 people. It is very ancient and very famous, vying with Morocco, Algiers, and Tripoli in commercial trade. Great caravans of horses, camels, and elephants ply between all these cities. I had travelling with me and composing the rest of my party six Abyssinians, who where of the Greek orthodox faith. We moved forward in all kinds of ways, sometimes on donkeys, again on camels, and in the high mountains on foot. It took us between five and six months to complete our explorations. All this time, whenever we were among any people, no matter how barbarous, I preached to them.

"About 200 miles over the desert from Timbuctoo we began to get in the gold-bearing mountains. The richness of the mountains increased as we advanced until the rocks were seamed with gold.

"From here I still extended my researches, preaching all the time when I could as I went. I had in view the searching of the sources of the two great rivers of the Bible—the Tigris and Euphrates, of Mesopotamia. Gaining facts, as I am, for a great ecclesiastical history of the Eastern Church throughout the world, and constantly visiting ancient museums, universities, and everywhere where manuscripts and tablets could be found, I thought it was important to search for myself for the source of those great rivers. I found them after great difficulty, and in doing this I climbed almost to the top of the two horns of Mount Ararat, in Armenia. Up towards the domes of Mount Ararat is a flat valley, large in area, which may be designated a plain

It is nearly 2,000 ft. above the sea. About 200 ft. above the plain I found the sources of those two great rivers. They are very close together. The water was extremely cold and clear.

"Then we proceeded to ascend to the top of Mount Ararat. We first chose the smaller horn. This is about 16,000 feet high, while the other is, as nearly as it is now ascertained, about 18,000 feet in altitude. We succeeded in getting up about 14,000 feet. There was perpetual snow there, and it lay very deep. A violent wind was blowing, and the mountain was so precipitous that we could not go farther. Accordingly, we retraced our steps, and when we got down to a point from which we could cross over to the other mountain, we went over to it and began climbing. We reached the altitude of 14,000 or 15,000 feet. The snow here also was very deep. We walked on till it was impossible to go any farther. We walked for hours and hours on the snow, and finally came down 2,000 or 3,000 feet.

"It was in the month of March that we made up our minds that it would be impossible to reach the top in such weather. We must wait till the snow, or a great deal of it at least, melted. We accordingly went still further below, and remained till April. Then we were abundantly paid for all our labour, for we discovered, what I feel sure was the ark, the actual work of Noah. I discovered it myself, being the first to see it. I saw it through a field glass at first, though we got so close to it that it was visible to the eye alone. We had reached a bight over the green grass, and at length in deep snow and over glaciers of probably 16,000 or 16,500 feet and within 1,500 or 2,000 feet of the top. Presently a great object came into view through the glass.

"The bow and stern were clearly in view, but the centre of it was buried in snow and one side of it had fallen down and was decayed. It stood more than 100 feet high, and was more than 300 yards long. The wood seemed very peculiar. It was dark reddish, almost iron-coloured, and seemed very thick. I saw it perfectly, especially the rear part. It is between 5,000 and 6,000 years old. Would the wood last for that time? Oh, yes. It would not were it not for the snow, but that has preserved it. Were it not for that, constructed even of hard wood as it is, it would have been impossible to last over 2,000 or 3,000 years. As it is, it will be preserved for ages and ages, perhaps 20,000 or 30,000 years,

"Never before have I told of the discovery for publication," said he, "and I never have told it to anybody, except to a few people in India. I will tell you why I did not announce it before. It is because some of the people I told it to laughed and would not believe it. Therefore I said I will not tell it, unless they ask me, but where they do I will tell the entire story. Meantime, I trust to the future to verify what I have seen. It was on April 25th, at about 2 o'clock in the afternoon, that I finally saw the ark upon the mountain. I was almost overcome. The sight of the ark, thus verifying the truth of the Scriptures, in which I had before had no doubt, but which for the sake of those who did not believe, I was glad, filled me with gratitude.

"The top of the ark that still remained was covered with a cap of from 5 to 10 feet of snow, but in other places, where the top has fallen in, I judge the snow is from 30 to 50 feet deep. I went clear round and came back again, and looked at the rear or stern critically, at length and with great care. Not a cloud nor a rift or even fleecy snow obstructed the view. It was all as clear and plain as the clearest sunlight could make it. Some of the rooms or turrets of the ark were broken half way by the snow and protruded over. I paused for quite a time, contemplating with gratitude and awe the discovery. I made the complete circuit of the dome, and had with the utmost care noted the great vessel from many different points. I thoroughly assured myself, gazing long and repeatedly at differents parts of the great craft that once for forty days and forty nights had on board of it every living and creeping animal and insect and every flying thing in the world.

"At length I called the attention of my companions who had arrived on the scene to it, and they examined it critically, and all admitted that they saw the vessel, the veritable ark of Noah."

TERRORS OF THE OCEAN.

Increased faith in the existence of an unknown marine reptile of vast size is felt since the recently-published testimony of creditable eye-witnesses, which to a certain extent confirms the attitude of science, which has never denied the possible survival of certain gigantic reptilian types of past ages, which would correspond fairly well with the numerous descriptions of the alleged sea serpent. Although such a theory is pooh-poohed by the ignorant, Agassiz believed in it, as do many eminent thinkers to-day, basing their opinion upon affirmative testimony of eye-witnesses. When it is considered that two-thirds of the earth's surface are covered with water, the depths of which, miles and miles beneath the waves, have never been approached by human explorer, who can say what huge and formless monsters may not lurk there in the darkness of an aqueous night never illumined by the sun's rays ?

The description given of a carcase recently found might very well apply to certain gigantic reptiles of the cretaceous (chalk) epoch, exceedingly numerous in those days, which are supposed to have been the ancestors of modern snakes and lizards. One species, the lidastes, was of about the same size, attaining a length of 45 feet. Another, the Mosasaurus maximus, was nearly twice as big, measuring when full grown not less than 80 feet. Yet larger was the liodon, hugest of all the mighty saurians of that vanished era, which had a long muzzle that is surmised to have been used as a ram in fighting. These enormous creatures, in general form resembling eels, ploughed the water with four paddles and propeller-like tail in pursuit of the fishes which were their food. Their heads were large and flat, and they swallowed their prey whole, being able to take in animals of greater girth than themselves, owing to the arrangement of their jaws, which were provided midway in their length with hinges.

In the age to which we refer real sea serpents not only existed, but their numbers were almost incalculable, as is proved by their bones left behind in the rocks of subsequent formation, and in many cases so perfectly preserved that entire skeletons have been found and mounted in the museums. After all, the question is merely one of size, inasmuch as marine snakes are very plentiful at present in some parts of the world. They swarm in the Indian Ocean, and a naval officer informed us the other day that he had seen them in shoals of thousands together in the Gulf of Siam. So numerous were they, that it was necessary to thread the cables while at anchor through barrels, in order to prevent the reptiles from climbing up the ropes and coming aboard while the ship was at anchor. Nor was such a precaution by any means superfluous, owing to the fact

that these serpents are most dangerously poisonous.

The seas from Madagascar to Panama and from Japan to New Zealand are thickly infested with them. Dr. Stejneger, the reptilian expert of the Smithsonian Institution, states that they are among the most poisonous of all known serpents, their venom being not less deadly than that of the cobra and rattlesnake. Furthermore, they are very fierce and aggressive, and will commonly attack human beings if they get a chance. They do not frequent the shallows, unless possibly for breeding, but live in the open ocean. When full grown they are from 6 to 8 feet long. Fishermen in the waters where they are found are greatly afraid of them. Their bodies are flat and the inside of them is almost wholly filled by the lungs, which are large in order that they may be enabled to stay beneath the surface for a long time without coming up to breathe. They have eyes modified for seeing in the water, so that when they are taken out of their native element they seem blinded and strike wildly. Their fangs, like those of cobra, are always erect.

Undoubtedly, the giant squid, which has only become familiarly known to science within a few years, has frequently been mistaken for a sea serpent. In all qualities which can render a marine monster horrible, this huge and frightful mollusc may be said to compare very favourably with any creature of fact or fiction. When full grown it weighs 10,000 pounds, having a body 50 feet long and two arms each 100 feet in length, as well as eight smaller tentacles. A model of a diminutive individual, measuring only 42 feet from the end of its tail to either tentacular extremity has recently been captured. Specimens of this kind are not infrequently encountered by fishermen in the Indian Ocean, where the humble toiler of the sea must be prepared at any time to see a monstrous creature with enormous goggling eyes rise out of the depths and fling across his boat a gigantic tentacle, armed with scores of suckers, so powerful that nothing short of horse-power can pull them off from the object to which they have been once fastened. For such an adventure the fisherman has always at hand a keen knife with which to slash off the tentacle before it has dragged him overboard in fatal embrace. He must work quickly, for the monster has another tentacle to help him in the attack, and it is hardly an even fight between one or two men and a beast with an arm reach of 100 feet.

As for the victim, once captured and held fast by the horrible sucking tentacles, he is drawn into the closer embrace of the creature's eight short arms, which are likewise equipped with suckers, and the frightful animal sinks with its captive to the bottom, where it tears him to pieces with its powerful parrot-like beak, goggling the while with great greenish eyes over its hideous repast. The giant squid, by the way, has eyes many times bigger than those of any other known animal, measuring quite 18 inches in diameter in a full-grown specimen. Those of the 42 ft. individual referred to in the preceding paragraph are each 1 ft. across. One point for which the great icthyosaurus of the mesozoic epoch was remarkable was its huge eyes, which were 6 in. in diameter, being set in bony cups like those of a bird; but they did not compare in size with the ocular organs of this mighty mollusc. In passing it may be remarked that, only a few years ago, an ignorant ship's captain, who never could have heard of the original reptile, arrived in port with a detailed and completely accurate description of a creature that he had seen in a calm on the bottom off the Pacific coast, which, if his report was true, must have been a living plesiosaurus. This extraordinary aquatic animal, supposed to have been extinct for ages, would answer very well to the conventional description of the sea-serpent, resembling a gigantic snake threaded through the body of a turtle, and having the head of a lizard, the feet of a crocodile, a neck like a serpent 30 ft. long, the ribs of a chameleon, and the paddles of a whale.

The "glistening eye" of the monster is a point particularly mentioned in the accounts given of what was in some respects the most remarkable appearance of the sea-serpent on record, inasmuch as the creature was viewed by thousands of people coincidently. It selected as the spot for exhibiting itself the bay off Nahant, in the Bay of Massachusetts. The season was summer, in the year 1818, and the weather was pleasant and calm, so that the crowds which gathered on the shore were able to observe the great "snake" to the utmost advantage, as it swam about between two projecting headlands, coming so near the beach as to cause many of the spectators to retreat affrighted. It appeared to be about 80 ft. long, of a dark colour, and held its head 2 feet out of water, through which it progressed at the speed of an ordinary steamboat. As it turned short, after advancing to within 100 feet of the land, and went seaward, its snake-like form became apparent, the body bending like an eel's. It was followed for miles along shore by people afoot and in carriages.

Attempts have been made to identify this sea-serpent with a supposed giant squid which may have found its way into the bay. These great molluscs not unfreqently run ashore, and they are very numerous in the North Atlantic. In fact, they are so plentiful in those waters that their dead bodies would frequently be found floating, were it not that they afford a favourite food for many fishes, and especially for certain whales. On November 30, 1861, between Madeira and Teneriffe, the French steamer "Alecton," commanded by Lieut. Bouyer, came upon an enormous specimen asleep. Many bullets that were fired at it passed through its soft flesh without doing it much harm apparently, and harpoons buried in its body would not hold. Finally, a rope with a running noose was slipped over the tail of the animal, but when it was attempted to hoist it upon deck, the enormous weight caused the rope to cut through the mass, which fell and sank. On July 8, 1873, according to affidavits made by the officers and crew of the barque "Pauline," they all saw three large sperm whales off the lee bow, being at the time in latitude 5° 13′ south and longitude 35° west. Suddenly a strange and unknown monster appeared just ahead, and threw an arm that was quite 100 ft. long around one of the whales, encircling the latter three times, and dragged it headforemost to the bottom.

The giant squid swims backward by expelling a stream of water from a huge syphon with which it is provided. While feeding at the surface, its tail projects above, and the convolutions of the long tentacles following after might easily produce to the eye the effect of a snake in motion. Another hideous monster of the deep is the octopus. This creature chooses for its haunt some dark cranny in the rocks, where it lies in wait, clinging with three or four of its great arms, while the others, waving, gliding, and feeling about in the water, are on the alert to grasp any prey. A man who is so unfortunate as to come within reach is at once embraced. Instantaneously the pistons of hundreds of suckers that cover the eight tentacles are drawn inward, the air is removed from the pneumatic holders, and, a vacuum being created in each, the victim is so pinioned that hardly a struggle is possible. The other arms are immediately wrapped about him, and he is drawn into a closer embrace, to be torn to pieces by the creature's beak and absorbed.

The Chinese regard these octopoda as a great delicacy for eating, and they are similarly relished in many other parts of the world. In the Mediterranean, numerous species of them, mostly of small size, are fished for, and along the coast of Algeria they are caught in a very curious fashion, by means of earthen jugs sunk in the water. Probably because the poulp is a soft-bodied animal, and, therefore, an easy prey for many enemies, it will eagerly take advantage of an opportunity to take shelter in a jug, from the mouth of which it can spread its tentacles for prey. Accordingly, it is not uncommon for the fishermen, on hauling up these queer traps after a few hours, to find every one of them occupied by an octopus. In the graves of the ancient Peruvians, inclosed with mummies, are found quite frequently objects which were at first ignorantly supposed to be dessicated human eyes. As a matter of fact, however, they are the corneal parts of the eyes of octopi, which must have been regarded by these people as charms of great value.

The term "devil-fish" is commonly applied to the great octopus, though the true devil-fish is quite a different animal, belonging to the family of rays. This latter is one of the most dangerous and ferocious monsters of the deep. When full grown, it measures 30 ft. from tip to tip of its tremendous "wings," which are merely very much developed fleshy fins. Its muscular power is so enormous that there are many well-authenticated stories of its carrying off small vessels, having become fouled with the anchor lines. A specimen captured off Barbadoes required seven oxen to draw it over the land. Accounts on less reliable authority are given of its assailing boats, swamping them with uplifted wing. A beak consisting of two fleshy horns that extend forward from its head assists it in grasping its prey. Being carnivorous, it would presumably devour human beings. Tales are told of its attacking divers, swooping from above, so that the unfortunate, while helpless to escape, beholds a living cloud settling over him with eager jaws to gobble. The devil fish is particularly fierce when accompanied by its offspring, of which it brings forth only one at a birth.

If there is a sea serpent, presumably one will be taken alive or dead some time. Then it will be known by its teeth what it feeds upon and whether it is dangerous or not. Its habits will be duly determined, and it will be ascertained whether or not its bite is poisonous. One reason why the bites of the venomous marine snakes of Eastern seas are apt to result fatally is that no severe pain follows them immediately, as with those inflicted by the cobra and the rattlesnake, and so no prompt remedial measures are taken.

SIFTINGS OF THE STUDY.

A Plunge into Space.

By Robert Cromie.

(*London: Frederick Warne and Co.*)

"A Plunge into Space" is a well and interestingly written work, after the manner of Jules Verne. That well known writer has, in fact, given his imprimature to the book in a special commendatory preface, in which he introduces the author as his pupil. The romance treats of a voyage to Mars, and is particularly appropriate just now that the planet is attracting so much attention. We will not "spoil sport" by letting our readers into the secret as to how the hero's voyage is accomplished. This, and the adventures on the planet, they must find out for themselves, by perusing the book. The published price is 2s.

RECENT RESEARCHES IN CRIMINOLOGY.

In opposition to all theories that held the criminal to be anatomically or physiologically differentiated, Dr. Manouvrier was most active. He pronounced the theories of Lombroso regarding the anatomical characteristics of criminals to be "but a recitation of the exploded science of phrenology." While admitting that such characters were present, he declared them to belong to the moral and criminal classes alike, and of no diagnostic value whatever in the study of "criminology." They were but structural or functional differences, while crime was a matter of sociology. "If Lombroso's theory, that the man was born a criminal, was to be taken as the rule, then it must be universal, and that men thus born inevitably committed crime. If it be the rule, then it must operate in all cases. That it did not so operate proved that it was not the rule, and therefore he concluded the proposition (*sic*) of anatomic characteristics peculiar to criminals did not exist."

Undoubtedly, the most unanswerable point urged against the holdings of the Italian school was that made by Manouvrier, when he asked, "Who form this class of honest and virtuous men that furnish the standard by which the criminal classes are to be judged?" As he pointed out, there may be among them the idle, vicious, brutal, and the evil disposed, who, if they have, so far, not fallen under the ban of the law, would still be classed with the non-criminal classes. The Bardsleys, Marshes, and Deemings of society might, in this view of the case, be classed anthropometrically with the morally exempt to-day, and to-morrow, when their crimes had found them out, they would furnish figures for the other side of the criminological ledger. This contention, though obviously most pertinent and important, was not replied to by any member of the congress.

If the Italian school appeared didactic in setting forth its postulates, their opponents were equally so in their espousal of the cause of the sociological genesis of crime. M. Lacassagne gave it as his opinion that "it is society that *makes* the criminals." Society has only the criminals it merits. Criminality was above all a social question. . . . It is not atavism, but the social surroundings, the social condition, which make the criminal. M. Pugliese considered crime "a social anomaly, and a consequence of a failure of the criminal to adapt himself to his social surroundings." Manouvrier asked, "Who can say what may not become of the man who has a sound body, if he be subjected to the continued pressure of adverse sociologic surroundings?" To him it was "the infantile life, familiarity with vice and crime, the surroundings, the want of moral training, sociological conditions," which produce the criminal rather than anatomic characters. . . . "It is idle," he continued, "not to recognise, in addition to the imperfections of human nature, the pernicious influence that is exercised by the evil education, the evil examples, the natural or factitious needs, the seductive occasions, the improper *liasons*, the repugnance to labour, the pleasures of idleness, the apparently natural willingness to eat the bread and enjoy the fruits of another's labour, or the satisfaction of a former escapade which brought profit and went unpunished."

Manouvrier called attention, in the following words, to a fact which must be admitted by all, yet which has a very direct bearing against the case for structural or functional peculiarities as the prime bases for crime:

"We have still to consider that there are many physiologic

peculiarities which become good or bad qualities, according to the circumstances, and these circumstances are simply the surroundings, the environment. An amorous temperament might be highly appreciated and complimented in one case, and yet become extremely dangerous in another. The audaeity and courage which might be a souree of pride in the soldier would become execrable on the part of the robber. . . . The best mechanic may become a most dangerous bank burglar or counterfeiter, and this eminence of crime is attained beeause of apparently natural exeellences which might have made him, and which went so far toward making him, an honest and successful man."

Rabourdin's wolf was alluded to by Manouvrier as an illustration of the effects and tendencies of environment in this problem in sociology. That animal its master had sueceeded in training to be an honest and respectable member of the sheep fold, refraining from attacking its charges, but contenting itself with its regular meals. "The regular meal to the wolf played the same *rôle* that the daily ineome does to the man, by the grace of which many persons who might easily beeome eriminals pass their days with high heads in soeiety, and enjoy the eonfidence of their neighbours with a reputation all their lives of being honest men." M. Laschi stated that the most revolutionary cities of Europe, like Paris, Florence, Geneva, were those in whieh the greatest genius and most vivacity of thought were manifested. Though this is obviously an example whieh would prove too mueh, from the point of view of the Italian school, yet Drs. Brouardel and Motet insisted that the presence of political crimes was due to an inferior average of intelligenee. Fanatacism, impressionability, and exaltation they considered to be prineipal faetors in political erimes.

The ease against the sociologieal causes as the efficient and only ones wherewith to aecount for these problems, beyond what has already been quoted as said in support of the position of the Italian school, was thus tersely summed up by Prof. Ferri :

" If crime be the exclusive produet of the social surrounding, how is one to explain the fact known to us every day of our lives, that in the same social status, and under equal circumstanees of misery, poverty, and ignorance, out of each 100 individuals 60 are not criminal, commit no crime, and out of the remaining 40, 5 prefer suicide to crime, 5 become insane, 5 become beggars or vagabonds, and only 25 out of 100 beeome criminals."

Returning to the diseussion of political erimes, Prof. Lombroso cited M. Taine, the historian, as referring them to the realm of political epilepsy.

This discussion between the two schools was re-awakened by several of the topies before the Congress, but, as has already been said, there appeared to be a common meeting ground on which the champions of each party could camp in harmony. This was well defined by Prof. Ferri, who said that crime " was a sort of polyhedron, of which each person saw but a special side. . . . Lombroso brings to light the biologic side of crime; Drill and Manouvrier showed the social; Pugliese, the legal view; Tarde presented the physiological side, and Moleschott and Brouardel declared crime to be a phenomenon at onee biologic and social." Tarde, while holding that there were no atomic characteristics of the criminal class, nevertheless believed that " there were organic and physiologic predispositions to crime. The function," in his opinion, " made the organ, and the nerve would model the bone; as the river determines the valley, so the erime makes the criminal." Commenting on his experiments with an epileptic woman, Dr. Brouardel stated that leucomainic toxique found in the veins of the insane or the melaneholy results from troubles in general nutrition. " Are they cause or effect? " he very pertinently asked. Drill pointed out that man was an extremely complex creature, his life depending on his environment, education, training, companions, and other like causes. " Whatever there might be in the physical or anatomical charaeteristics of a man which would point towards his crime or the possibility of its commission, that eaeh of these elements entered into and became a factor, and were each and all of them to be considered in deciding this question." Lacassagne conceded that social influences " might modify the organic characteristics, and thus create these anatomic anomalies which were relied upon by the Italian school."

These statements of the interdependence of the organic and sociologic factors in crime production were undoubtedly " the sense of the meeting," and outlined an intermediate territory between the opposing camps of Lombroso and Manouvrier, in which even these extremists could dwell at peace with each other. During these most pregnant discussions classifications of crime and the criminal class were announced that will be of interest here. Ferri divided the criminal classes into five divisions, viz. :

The born criminal;
The insane criminal;
The criminal of occasion;
The criminal of passion;
The criminal of habitude.

The first of these, the born eriminal, Dr. Magnan divided into three classes, as follows :

Intellectual faculty predominant; morals defeetive.

Morals predominant; intellectual faculties defeetive.

Apparent equilibrium between morals and intellect; but usage defeetive, as in application, effort, emotion, etc.

Supplemental to these classifications, Manouvrier proposed the following elassification into three divisions :

Inexplicable Crimes: Viewed from the normal standpoint, such as are committed by the insane, epileptie, idiots, and monomaniacs.

Crimes of Delirium: Sueh as are due to anger, alcoholic frenzy, jealousy, and fear.

Crimes of Intention or *sang froid*, or sueh as were deliberate, of malice aforethought, or premeditated.

While relegating the first two classes to the realm of pathology and teratology, it was only the latter class, the crimes of intention, he asserted, which should claim the attention of a Congress of Criminologists. It was evident, however, that this opinion was not shared by other leaders in the Congress, for it was to the abnormal physiological or anatomieal condition that most attention was given, and rightly so it would seem. The medical membership in such an association would be an anomaly, a useless limb, if it were only the normal in crime that was to be considered. It is its very abnormality, which each year's experience convinces us is of more frequent oecurrenee than has hitherto been held, that makes crime the proper study for an assoeiation composed of legal and medical men.

(*Concluded from last week.*)

If you have an idea for a patent, write to the Editor of SCIENCE SIFTINGS, giving the outline of your scheme. The communications will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

CELESTIAL WANDERERS.

An unusually brilliant and varied collection of attractions is spread out before the star gazer at this period of the year. There is Mars, which has just been at the brightest and most interesting aspect in which he has appeared since 1877, and who will not be so bright again until 1907. He rises early in the evening and is in view all night. Then there are the planets Saturn and Jupiter, and the first magnitude stars Arcturus, Vega, Spica, Antaries, Altair, and late in the night, Fomalhaut, and Capella. In addition, there are the regular August meteors, which have always been of great popular interest. Meteors are often called "falling stars," or "shooting stars," but, of course, there is no propriety in this designation, for they are not stars at all or fragments of stars. Stars are immense bodies, larger than our sun probably in most cases, and are situated at tremendous distances from us.

The nearest of the stars, it has been estimated, is about 20,000,000,000,000 miles away from us. Meteors are supposed to be fragments of comets, and are near enough to the earth sometimes to be drawn into our atmosphere. Meteors may be seen on almost any clear night in the year if watched for carefully for half an hour or an hour. There are certain nights every year, however, in which they are unusually numerous. This peculiarity was observed long ago, before the true character of these bodies began to be even guessed at. On the nights of the 9th, 10th, 11th and 12th of August, and on those of the 11th, 12th, 13th and 14th of November, more of them may be seen than at any other time of the year. On or around the 20th day of April and the 27th of November they have been seen in considerable numbers in certain years of the past, but not every year.

Ordinarily the August meteor display is rather more varied and interesting than that of November 11, 12, 13, and 14. Every thirty-three or thirty-four years, however, this November spectacle is splendid and memorable. As has already been mentioned, the August meteors are more numerous from the 9th to the 12th than at any other time in the month. They may be seen in any part of the sky, but the general direction of their movements will usually be towards the south. If their paths be traced backwards they will be found to emerge from a point of the sky situated in the north-east. This spot is occupied by the constellation Perseus. As they appear to come from Perseus this star group is known as their radiant point, and they are called Perseids. Perseus may be seen just above the horizon in the north-east on these nights at a little after 9 o'clock. It may be traced out in this way. There is a striking group of stars, with its five leading orbs, arranged in the form of an expanded W, the top of the letter being turned towards the west, in the north-west these nights, and it is high above the horizon at 9 o'clock. This is Cassiopeia, or the Lady in Her Chair. The Milky Way, which is an irregular zone of faint white light stretching across the heavens now from north to south, runs through Cassiopeia. A direct line from Cassiopeia down to the horizon in the north-east will touch Perseus. Through this constellation the Milky Way also runs. A little after midnight Perseus will be due north, and will then be about half way between the horizon and the zenith, and just before sunrise it will be low in the north-west.

How is it that these meteors strike us in August always, and at the same period of the month? The answer is easy enough now, but it was not discovered until comparatively recent times. Meteors are supposed to be the remains of comets. At any rate, a regular stream of these minute bodies is, in every case where found, strung out in or very close to the orbit of a known comet. The August meteors' path coincides with that of the second comet of 1862. These meteors are found all along the trail of this comet, and form a regular continuous stream around the sun. This stream is elliptical like the orbit of the comet, and the sun is in one focus of the orbit. The orbit of the earth intersects that of the meteors about the point which the earth reaches every year around August 9. As the earth dashes along its course, it plunges into this meteor stream at this date. Many meteors are then turned from their course by the earth's attraction, and in flying towards us they are ignited by the resistance offered by the earth's atmosphere, and thus become visible to us. The long train which they leave after them is composed of the glowing ashes into which they are reduced.

A like reason accounts for the fact that we see meteors in unusual numbers a few nights before the middle of November. The meteors of that date are strung out all along the orbit of Tempel's comet, forming a zone around the sun. This zone intersects the earth's orbit at a certain point, and this point the earth reaches about November 11 each year. These meteors have the constellation Leo for their radiant point, and are called Leonids. Leo sets before the sun now, but about the middle of November it will rise over in the easterly side of the sky a little after midnight.

How large are the meteors? The vast majority of those which we see are probably less than a pound weight each. These are burned up before they come to the earth, and only their dust reaches us. Our atmosphere extends outward for 100 or 125 miles, and this provides a needed protection to us around the meteoric dates, for this envelope saves us from a terrific bombardment every August and November. Without it every one of those tiny bodies would strike the earth, and with a velocity which would cause the greatest destruction. Many millions of these meteors come into our atmosphere every twenty-four hours. Those which we see form only an infinitesimal part of the number which come in our direction. Many are burned up before they can become visible at all, and others come in the daylight, when they cannot be seen.

Some meteors come very near the earth. These are doubtless many pounds in weight. They leave a very long and bright train, and are called fire balls. Then there are other masses, some of them many tons in weight, which run the gauntlet of the atmosphere successfully and reach the earth. These are called meteoroids or aerolites. In these bodies many of the elementary substances contained in our globe have been found. Some of them consist of nearly pure iron, while others contain lava, flint, rock of different sorts, and nickel. In the earth about sixty-four elements have been found, and twenty-four or twenty-five of these have been traced out in the aerolites, which have been examined. None of these bodies so far found have contained any elements unknown on the earth.

The tiny bodies which enter our atmosphere during August have come to us from a distance far beyond Neptune, which marks the remotest planetary outpost of the empire of the sun. The orbit of the November meteors is much narrower, extending outward only a little beyond Uranus. The time in which the August meteors make the circuit around the sun is not known, but it is likely to be several

hundred years. Centuries have passed since they were in this part of their course before, if, indeed, they were detached from the parent body at that time and had an individual existence. The comet in whose train they travel has a period of about 125 years, but these atoms probably move slower. Perhaps when they were last near the part of their orbit cut by the earth Columbus had not yet set sail on his great voyage of discovery, and the Atlantis of the old Greek geographers, far to the westward of Europe in the Atlantic, was yet only a dream.

It was mentioned in the early part of this article that once every thirty-three or thirty-four years the November meteoric displays are notably brilliant. The first one of these of which we have any record by a scientist was that of November 12, 1799, which was observed by Humboldt in the Andes. On November 13, 1833, a splendid display occurred in the United States, in which the falling stars were almost as plentiful as snowflakes in a light snow storm. There was a brilliant display in this country in the same month in 1867, while another is looked for in 1899 or 1900. The meteors are not diffused equally all along the November stream. There are immense masses of these tiny bodies in some parts of the stream, and these masses strike the earth's orbit every third of a century or thereabouts. This is the way the astronomers explain the thirty-three or thirty-four year spectacle.

USEFUL INSECTS.

We frequently hear a great deal said about the constant struggle for life and the survival of the fittest, but many of those who discuss the subject think only of its bearing on human life, forgetting that the same influences are constantly at work among the animals, and even among the little creatures that live amid the plants and flowers, and have their own work to perform, a work of the greatest importance to man.

The best known of all those insects which may be designated as useful is the lady bird, a pretty little hemispherical beetle. It is very common everywhere, but, although so familiar in its perfect state, its larva is comparatively little known, in spite of the fact that when in this latter condition it does its most effective work in killing plant lice, which are greedily devoured by the larva, an ugly-looking little grub, pointed at the rear, provided with numerous little knobs and prickers, and with six legs near the fore part of the body. Any one who watches its vigorous attacks on the lice on a rose bush, will be convinced of its great usefulness, and will appreciate the fact that it is better to allow a pernicious insect to escape, than to kill a useful one. One who cannot, with certainty, distinguish such larvæ from other similar worms, should be careful not to tread, as so many do, on any worm without consideration.

The gauze-winged fly is as useful as the lady bird, but not as well known, although much more liable to be killed by men, for frequently a chance wind will catch great numbers of these flies, and carry them into dwellings. Their appearance in large numbers is considered an evil omen by the superstitious, and even educated people are sometimes obstinate on this point. Many of the gauze-winged flies belong to the neuroptera ; their larvæ, are long and worm-like, and extremely ugly in appearance. We do not prize them as they deserve, until we understand that they are active destroyers of vermin.

Very few need any description of the Libelluladæ, or, as they are commonly called, dragon flies or devil's needles.

Wherever we wander by the water, be it river, lake, brook, or pond, if there are not too many water birds, geese, ducks or swans, we find innumerable dragon flies moving about in their strange, quick way. Although so common, comparitively few know of their propensity for devouring Hessian flies, and other grain-destroying insects. Their larvæ, which are as ugly as they are greedy, live under water, where they feed on other larvæ, on gnats and other creatures, and are troublesome to man, and are also developed under water. Both the larvæ and the fly are greedy creatures, and it is on account of this greediness that they have been named "dragon flies."

There are other extremely useful insects that we do not see as often as those of which we have been speaking, among them the ichneumon wasps and flies. Very few realise their worth. Each female of the many species bores into a caterpillar, or other larva—the flies of one species generally restrict themselves to certain caterpillars—and lays one or more eggs in its body. These eggs hatch and the larvæ which comes from them live on the caterpillar, utterly destroying it. As they increase very rapidly, they limit the increase of other insects. The amount of destruction caused in woods, by caterpillars, would be enormous, and man would be powerless to stay it, except by cutting down or burning the woods, but nature comes to his aid and preserves the equilibrium ; in a short time the caterpillars are killed, and their destruction ceases "all of itself," as people say. Upon closer study these ichneumon flies are found to be very interesting creatures. The females of some species lay their eggs in those of other ichneumon flies, so that one parasite develops in another parasite.

Among the most useful of all insects are the so-called caterpillar flies, which are scarcely known, even to educated people. There are many species of them, although they are not so numerous as the ichneumon flies. They are useful, because they are parasites, laying their eggs not in, but outside of, the bodies of caterpillars. If, when we are in the woods, we see grey, black, or yellowish flies buzzing noisily about in the grass, we should be careful not to destroy them, for their young are parasites that live on the most destructive caterpillars.

We have only referred to a few of these destroyers, but others might be mentioned, such as the ant and carabid, including the ground beetle, which lives on caterpillars and larvæ of other noxious insects. It would be not only impossible, but also unnecessary, to attempt to describe them all. Whoever feels inclined to investigate further the great number of insects that are more or less useful, can do so by the aid of the many good natural histories.

Our Monthly Edition.

SCIENCE SIFTINGS may now be obtained in Monthly Parts, bound in buff wrappers. Price 6d., or post free, 8d., of any Newsagent ; W. H. SMITH & SON'S bookstalls ; or of the Publisher, 78, Fleet-street, E.C.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

SOCIAL SCIENCE.

GIVE AND TAKE.

"Human labour, through all its forms," writes an eminent political economist, "from the sharpening of a stake to the construction of a city or an epic, is one immense illustration of the perfect compensation of the universe—the absolute balance of Give and Take, the doctrine that everything has its price; and if that price is not paid, not that thing, but something else is obtained, and it is impossible to get anything without its price." This fact is manifested as distinctly and significantly, he goes on to point out, in the ordinary processes of industry as in the great transactions of history. It runs through all the multifold operations, interests and tendencies of civilisation. Nothing that is worth having is to be had at what we call a bargain. The cases in which this rule appears to be violated are not really inconsistent with the general theory when all their circumstances are carefully considered. In some way the full price is paid, and the law of compensation is duly enforced. The various expedients for the promotion of prosperity at less than the fixed and regular cost have turned out to be failures and mockeries. It is not possible for the ingenuity of man to devise an effective method of exemption from the influence of certain fundamental and inexorable truths of the philosophy of life. The equilibrium of gain and loss is maintained in spite of all interfering agencies, and progress ensues only in proportion to the strife and toil and sacrifice by which it is practically earned.

The Homestead strike, of which the world has recently heard so much, for example, is but a repetition of thousands of similar instances, and a fresh presentation of a problem that dates back to the beginning of the world. It is not merely a local dispute about wages, a transient disturbance of industrial peace: it represents an intrinsic spirit of antagonism in human affairs which is constantly working out the doctrine of compensation. That is but a narrow and misleading view which regards it as a surprise or an accident, and ignores its obvious relation to the general system of civilisation. The questions that it involves, the interests that it affects, are far-reaching and vitally important. It puts before the world in a definite and startling way the fact that society has not yet acquired the power of controlling and adjusting dangerous forces, and that some of our cherished notions in that respect are of doubtful virtue, to say the least. We can readily see in the presence of such an occurrence that we have still much to learn in the matter of causing legal agencies and proceedings to meet all emergencies in a prompt and decisive manner. There are evident reasons for modifying the common belief that the reading of the Riot Act is sufficient to quell every violent outbreak and insure the safety of person and property. It is not true, we are impressively admonished, that the reverence of citizens for the majesty of the law is always a potent restraint where controversies assume a bitter and malignant aspect. We are taught that blood may be dashed in the face of a community on sudden provocation, in spite of all the established appliances for the conservation of public order and the protection of private rights.

There are times, manifestly, when legal safeguards are inadequate, and society is at the mercy of those hostile influences which it is supposed to have under subjection. A body of citizens, moved by a sense of wrong, real or imaginary, may defy the law and its officers, and usurp the authority of regulating things to suit themselves by arbitrary and destructive means. This is one of the ways in which the absolute balance of give and take is preserved. The elements of the situation gradually converge to a given point, and a crisis is inevitable. A period of prosperity engenders impulses and purposes that lead to trouble and injury. The losses thus brought about are a part of the price that is exacted for things of permanent value. It often happens that the cost seems cruelly exorbitant, but the final result is more profitable than harmful, counting the contingent as well as the direct advantages. The pecuniary waste falls heaviest, of course, upon those who are immediately engaged in the struggle, but it is shared to some extent by the whole country, and the whole country helps to repair it and to apply the lessons that it teaches. There is nothing more conducive to the improvement of existing conditions than a positive demonstration of the unsoundness of a prevailing opinion or practice; and it is only in the school of experience, where the tuition is costly, that such wisdom is obtained. The policy of letting well alone is admirble as long as nothing better can be done; but progress implies the discovery of new and preferable facilities, and discoveries of that kind are reached only through contention and convulsion.

It is an accepted fact that a strike always costs the strikers more than they personally gain; but this does not necessarily mean that it is detrimental to the cause of labour or to the prosperity of the country. Such an event has an educating effect that is always more or less beneficial. It shows the weak places in current theories and causes mistakes of judgment on the part of both employers and employees to be rectified. A better knowledge of the conditions of industry and the sources of profit is secured, and that sort of knowledge insures a greater degree of success for productive energy in all occupations and enterprises. The few play a losing game, but the many win in the sense of deriving from an unfortunate collision a more intelligent understanding of the principles of justice and the rules of prudence and expedience. It is quite as useful to ascertain what is wrong as to learn what is right in our various devices and customs for the regulation of the affairs of society, and a strike is likely to emphasise such wrongs and to suggest the proper remedies for them. The strike may be unjustifiable so far as the alleged grievances of the strikers are concerned, and yet serve a wholesome purpose by the discussion that it provokes and the revelations that it makes. This idea is confirmed by the known results of the majority of these undertakings; and it will not do, therefore, to estimate them simply according to their bearing upon a particular community or a special class of workmen.

There can be no dispute about the right of labourers to organise for the purpose of protection against injustice and to assist one another in making the most of their opportunities. It is equally true that they have the right to quit work when the terms of service do not suit them, and to use all legitimate means for getting higher wages. Their labour is worth all to them that they can induce anybody to pay for it, and they are not obliged to dispose of it at a lower price than they think they ought to have for it. The capitalist has no right and no way to obtain labour at a cheaper rate than the labourer is willing to accept. It would be absurd to say that the power of compulsion is on the side of the employer and that he can force men to work for him at such prices as he is pleased to establish. The most that he can do is to refuse to pay more than he thinks he can afford, and to close his business if he cannot find men who will take what he offers. He cannot call upon the legal authorities to pre-

vent men from leaving his factory and seeking employment elsewhere. They are free to go at any time, without a moment's warning, no matter what the effect may be upon his interests. He has no recognised claim upon them beyond that of a purchaser of their labour, subject to the same rules that govern purchasers of other commodities. He is not forced to buy at the price demanded, but neither can he force anybody to sell at any price. In other words, he is not legally bound to furnish men with employment on terms that are objectionable to him; and that is the limit of his rights in the case. Beyond that, the labourer is master of the situation, as he controls the article which the employer must have, or his plant must stand idle.

But there is no law requiring men to join labour organisations, and a great many of them prefer not to do so. In fact, the unorganised labour element is larger than the organised element, including all branches of industry in the computation. The rights of the two elements are identical under all circumstances, and the chances of employment belong as much to one as to the other. It is for the employer to say what distinction shall be made between them, if any, on account of differences of skill or other practical considerations. But the labour organisations assert the right to monopolise all the work that there is to be done in various trades and forms of business, and to dictate the wages that shall be paid for it, thus shutting out unorganised labour, and taking away from the employer the advantage of competition in the market where he buys an indispensable article. When organised labour strikes it does not merely refuse to perform a certain service on certain terms, but insists that other men who are ready to do the work on such terms shall not be allowed that privilege. It is clearly impossible to reconcile this discrimination with the idea of honest devotion to the interests of justice and the welfare of the labouring population. The right to earn a living belongs to every man, and when he is deprived of it by force one of the gravest of wrongs is perpetrated.

The contention that corporations like the Carnegie company are under more obligations to their employees than individual employers has some force, but not enough to justify the claim that when they once hire a man they are bound to keep him in their service as long as he wants to stay and at such wages as he chooses to ask. A corporation is a creature of society, having special functions and privileges, and as such stands in a relation to its employees that is different from that of a private citizen who has others working for him, but this difference does not imply a right of joint ownership on the part of the employees with the corporation in its property. The Homestead strikers got their full share of the profits of the business when they received the wages for which they had agreed to work; there was no bargain to the effect that they should gradually acquire a title to a share of the company's investment and a claim to permanent employment. It was not in the power of the company to prevent them from deserting its service, and when they did so desert, the company was released from all obligations to them. This is the common-sense view of the question, and common sense is the true guide, after all, in the analysis and determination of issues that involve the relative rights of capital and labour.

There will always be strikes, of course, as occasions arise for readjusting our opinions and policies. The struggle between opposing influences may seem to stop from time to time, but in fact it goes on constantly. There are truces and compromises, but no treaty of enduring peace, and it is well for us that there is not, since peace in such a respect would mean stagnation and decay. We have nothing to fear from conflicts that put current sentiments to a practical test, and show us what is true and what is false. They may be costly for the time, but in the end they will pay. It is not to be supposed that we can carry on our vast and complicated machinery of progress without occasional jars and shocks. New conditions and responsibilities intervene year after year, and we have to adapt ourselves to them by such means as are within our reach. We cannot reasonably hope to hit upon the best course in every instance, and when we make mistakes we must expect to be punished for them, remembering that it is impossible to get anything except at its logical price. The millennium is yet a long distance ahead of us. Our civilisation has wrought wonders, but it has not abolished the law of compensation which awards us only what we are found to have fairly earned by our intelligence and integrity after proper deduction has been made for our errors and follies, our superficial views and our disappointing experiments.

HELPFUL HINTS.

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

MISCELLANEOUS

A SUFFERER.—Many thanks for your letter. You may rely on our continuing our exposures of Mr. Harness. Send us your name and address—not for publication.

JOHN PAUL.—Many thanks for your letter, and the good work you are doing for us. The change of title is a very knotty point. We quite agree with your conclusions.

S. M. BURROUGHS AND OTHERS.—Many thanks for suggestions about title. They will receive every consideration.

J. STRATFORD-BRADISH.—Your letter is excellent, and to the point. We have not yet finished with the subject of so-called Electric-belts.

TO NUMEROUS CORRESPONDENTS.—All letters unaccompanied by the name and address of the sender, are relegated to the waste-paper basket.

GEO. H. RYAN.—Your idea of enlarging the photographed images of heavenly bodies is very ingenious and interesting; but not new. Ever since the camera was first applied to astronomical work, there have been attempts to magnify the details of the image by photo-enlargement. Although no remarkable additions to knowledge have yet been made in this way, the method is a good one, and we expect more from it in the futnre.

*** Owing to the pressure on our space, we are again compelled to hold over many replies.

SCIENCE SIFTINGS PUZZLE.

(The Knight's Promenade)
The King of Puzzles.

Price 3d. At all Bookstalls, Newsagents, and Fancy Goods Dealers

PRIZES FOR THE WEEK ENDING SEPTEMBER 3rd.

The senders of the first twelve letters, opened by us on Monday, September 5th containing correct solutions to this Puzzle, will receive 2s. 6d. each.

The two senders of the largest number of correct solutions, received by us on or before Monday, September 5th, will receive 10s. each.

No letters for these Competitions will be opened until the first post on the 5th inst. But competitors may send in their solutions as early as they please.

Each competitor must send the Coupon attached to the puzzle, together with the one printed on page i. Envelopes to be marked respectively, "Puzzle Prize 2s. 6d.," and "Puzzle Prize 10s."

NOTE.

Competitors or the 2s. 6d. prize may send in any number of solutions, but each must be in a separate envelope, accompanied by the two coupons.

Any difficulty in obtaining this puzzle should be immediately communicated to Publishers, who will at once take steps to rectify the matter

*** The Coupon will be found on page i.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*, 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, SEPTEMBER 10, 1892.

SCIENCE NEWS AND NOTES.

"Out from the inexhaustible womb of time come millions of the children of progress, thought vitalised and materialised into things and laws and plans that mankind may use to its betterment, *if it will.*

Our Title Competition

is now closed. We have received so many post-cards that we shall not attempt the task of counting them, but we have read them through very carefully, and we trust to be in a position to announce the name by which SCIENCE SIFTINGS will in future be known at an early date—possibly next week. "A rose by any other name would smell as sweet," and as the contents of our paper will remain unchanged, we know we shall have quite as many adherents under the new name, while by it we also hope to attract those who have been frightened away by the portentous word "science."

Mr. Harness's Patients

continue pell-mell to dispose of the universal specifics against all complaints with which he supplies them. In fact, some of the sufferers are so anxious to be rid of his belts that, as we pointed out in these columns last week, they actually offer them at enormous reductions, many after a fair trial, and some without ever having used the appliances. Now this cannot be alone because the belts have been found useless, but because the overwhelming testimony we have been enabled to advance against them has been accepted by every right-thinking individual. This is as it should be. Mr. Harness's electropathic belts having been adjudged useless in a court of law, he has deemed it wise to lie *perdu* instead of achieving further publicity by challenging our statements. Mr. C. B. Harness is now advertising that "army surgeons and military officers in India declare it to be a perfect cholera belt, and an effectual safeguard against the terrible malady." We do not believe that army surgeons have made any such statement; if they have, they have lied, and transgressed the rules of the noblest profession into which a man can enter. Every medical man in the world will uphold this opinion, and likewise maintain that not only are Harness's belts *no* safeguard against cholera, but no safeguard against any complaint no matter how trifling. To those who are about to purchase one of Mr. Harness's belts, we would recommend the perusal of the articles and paragraphs that have appeared in our issues of August 6, 13, 20, 27, and September 3. These can be obtained of any newsagent or of the publisher by sending stamps to cover cost and postage.

The Fearful Heat Wave

that has visited America and the continent with such sad consequences is popularly supposed to be a unique occurrence. In reality it is nothing of the kind. The so-called heat waves are of nearly annual occurrence, but this year they seem to have reached a much higher point than usual. The sickness and mortality have also been proportionately increased. As there appears even now a possibility that our shores may suffer from a similar visitation, it will not be uninteresting to analyse the evil effects and their preventives of these heat waves.

The Ill Effects of Heat on the Body

do not always give rise to the same phenomena of manifestations, but they are nevertheless the varied results of one and the same cause and pathologically are allied to one another. The mechanism by which they are brought about is through the nervous system; but the heat is not, in many cases, the only or even the dominating factor present. A man falls down pulseless, or nearly so, from heat exhaustion as the result of exertion and fatigue in hot weather, with a pallid face and a cool, perspiring skin. If he is placed in the shade, exposed to a current of air in the recumbent posture, and given a stimulant, he soon recovers. An infant or child living in a city suffers from diarrhœa attended with notable prostration. The illness is mainly attributable to the depressing effect of heat and a vitiated atmosphere on the child's nervous system. The best thing, the *Lancet* points out, is removal to the seaside or country; if children were sent away from the defiled atmosphere of overcrowded towns as soon as the hot weather began they would be spared a large amount of suffering, sickness, and mortality. If this cannot be done, the great thing is to keep them as cool as possible in a well ventilated room.

Sunstroke and Heat Apoplexy,

however, are forms of heat fever of a formidable kind, in which the temperature of the body rises rapidly, attains a high figure, and is attended with unconsciousness and danger to life. In sunstroke the solar heat acts directly on the brain and spinal cord, whereas in heat apoplexy the attack may occur at night in crowded tents or houses, and is commonly attributable to other causes than heat alone. The *Lancet* also tells us the best methods of guarding against these effects of heat, and they are certainly the simplest and most obvious, viz., garments light in colour and weight and loose enough to admit of free action of the skin and respiratory movement and the circulation of air currents; the occupation of airy and spacious rooms and temperate living; the avoidance of causes of fatigue and depression and an open-air life, together with abstention from exercise and exposure at those periods of the day which common sense would indicate as the least suitable. The important pathological fact to be considered and dealt with when sunstroke or heat apoplexy actually occurs is the

exalted temperature of the body; the reduction of this abnormal temperature is the primary consideration, and its accomplishment by the application of cold to the surface—cold water, ice, and currents of air—is *the* matter to be at once attended to. Apart from these phenomena, the immediate and remote effects of heat on the nervous system are sometimes very serious. Maniacal delirium may occur at the time of the attack, and the patient be afterwards very liable to suffer from violent neuralgic headaches, sleeplessness, and irritability, and to be unable to remain in heated or crowded rooms or expose himself to the heat of the sun.

Profound Solar Disturbances

have been freely credited as the cause of the hot weather to which we have referred. So many of the earth's natural phenomena find their origin in the solar radiation, that it is impossible to vary either the amount or the distribution of the solar energy without markedly modifying terrestrial phenomena. Such influences, however, are not limited to terrestrial phenomena; they must extend beyond the earth and be shared by all the members of the solar system. Natural phenomena form but links in endless chains of cause and effect. An evolution or expenditure of energy, such, for example, as that following a sun spot, produces a number of allied phenomena which are themselves the causes of subsequent phenomena, and these in turn the causes of still other phenomena, the chain extending in most instances far beyond our ken. There has been unusual solar activity during 1892, as has been evidenced by an unusual number of sun spots. Some of the conclusions based on this are, however, the merest speculation founded on coincidence.

An Interesting Theory

on the subject has, however, just been advanced by Prof. Houston, and is decidedly worthy of consideration. The recent opposition of Mars has brought that planet nearer the earth than she has been at any time since 1877, and nearer than she will ever be again until 1909. The opportunity has, therefore, been particularly good for studying those peculiarities of the surface that have always been of such interest to astronomers. Some observations recently made on Mount Hamilton appear to show a marked decrease in the mass of snow within the polar caps, as is inferred from certain characteristic markings at these points of the planet. This disappearance is unusual, and Prof. Houston deduces from it an indication of unusually hot weather in our sister planet. The Martian thermometer has probably been very high, and the weather has, to form a phrase from the fiery colour of the planet, been at a red heat. It may be, then, he thinks, that the unusual proximity of Mars may be the cause of the great number of sun spots to which we have referred, in which case we may thank Mars for the recent terrific heat.

A Very Thirsty Topic

is this hot weather, and therefore, a few words about thirst and thirst quenching will not be out of place. Many persons are under the impression that thirst is quenched by the flow of the fluid over the surfaces of the mouth and throat; but this is next to impossible, although the sensation of coolness does exercise a certain amount of very transient palliation. The sensation of thirst returns again rapidly as the cool liquid becomes warmed, by contact with the internal heat; and it would be quite correct to say that, with the exception of the very temporary numbing as it were of the sensitive nerves of the mouth and throat, the thirst was quite unquenched. The moisture of the liquid passing down the throat has little or no effect upon the local distress, until it has passed into the stomach, been absorbed and taken up by the vessels which convey it to the throat.

These are Remarkable Facts,

and borne out by practical experience—water will not quench thirst by local application only—you may hold water in the mouth without swallowing it, but it will not allay thirst. If it be cold when first taken into the mouth it numbs the sensitiveness of the nerve fibres that are irritated by the parched membrane above them; but the relief is not permanent by any means, and passes off as the coolness is dispelled. Here, then, we have a peculiar fact to deal with—that the act of swallowing water does not relieve thirst; but it must not be understood that water, *after* it is swallowed, does not have the desired effect, for it is then only that it affects the complaint. The skin has the power of absorption, so that if the body be plunged into a fluid, absorption will take place freely. In this way also thirst may be relieved—even without drinking at all. Fluids injected into the bowels, it is pointed out by a writer in the *Mineral Water Trade Review*, will relieve thirst; and thirst will relieve itself in course of time, if produced by unusual exercise, even without imbibing fluid; the sense of thirst caused by the drying of the throat and mouth, being only on the surface, and, therefore, not permanent.

The Phenomenon of Thirst

is explained by the fact that the internal supply of watery moisture to the cells that line the month, throat, and air passages, has been deficient in some respect, and thus the fluid has become unduly tenacious and consequently difficult for absorption by the cells. The moisture conveyed by the blood vessels to the epithelial cells is not pure water but a fluid containing albumen and other elements of nourishment. Therefore, when the albumen is in excess, that is insufficiently diluted, it is left, through the evaporation of the water, a sticky and then quite hard mass, covering the mouth and throat. This is "parched thirst," and all we have to do in order to remove this sensation is to administer a fluid that will most readily dissolve the albuminous crust. The experiment has shown that plain water is too slow in its action for this purpose, but a solution of bicarbonate of potass, or nitrate of potass, acts like a charm and dissolves it.

A Serious Danger

has been unearthed by the recent experiments of MM. Lortet and Despeignes. They have proved that the bacilli of tuberculosis may be stored and spread by subsoil worms, which can preserve the bacilli and reconvey them to the surface of the ground, many months after the body that originally contained them may have been interred. It is needless to publish the full details of the experiments here, suffice it to say that after being digested by worms and evacuated on the surface of the earth, it was found that the bacilli of tuberculosis were in full possession of their infective virulence. It is, therefore, conclusively indicated that infective *debris* should not be consigned to the subsoil without complete destruction of all germs, otherwise they may be reconveyed to the surface, to become again the source of contagion.

The Curious Fact Discovered by Tesla

that electric currents of extremely high potential and alternating (or changing their direction in the circuit) with

great frcquency—such as 20,000 times a second—have no injurious effect upon the human body, while currents of lower potential and alternating much less frequently would instantly destroy life, has just been the subject of a paper read by Prof. E. J. Houston before the Franklin Institute. According to Prof. Houston's theory, the alternations take place so rapidly that the superficial portions only are traversed by the discharges. The more deeply seated, vital organs being thus free from current, such discharges are necessarily harmless. As the frequency of alternation increases, the body becomes more and more protectcd, until, whcn the frequency becomes as great as that of the ether waves which cause sunlight, they would probably produce on the surface of the body the same genial effects as are produced by the light and heat of the sun, with which they are probably identical. It is worthy of note in this conncction that lightning strokcs, which are of enormously high potential and probably alternate with great frequency, do produce physiological effects upon the human body so violent as to often result in death. But so little is actually known about the conditions under which lightning manifests itself, that any comparison between it and the currents produced by Tesla must necessarily be very unsatisfactory.

Nothing Political has a Place in our Columns,

but we cannot help giving prominence to the views of General Hutchinson, who writes to SCIENCE SIFTINGS to express his belief that "the advances of Russia, now assuming a formidable aspect, would cease, had we an efficient, far-travelling, navigable balloon." We certainly agree with these observations, apart from their bearing on the advance of civilisation generally. Our correspondent continues: "Your paper, from its character, has such influence that I earnestly trust you will take a part in encouraging Government to take early steps to obtain some kind of efficient war balloon." While modestly acknowledging the compliment to our influence, our correspondent may rest assurcd that we shall do everything in our power to promote the welfare of this important department of science. General Hutchinson's proposed design for a balloon is rather too lengthy to be published here ; but it possesses many commendable features, and we recommend any of our readers interested in ballooning to write to the General (The Lodge, Silvcrdale, Eastbourne), who, we feel surc, will be pleased to forward a copy of his article on "Navigable Balloons."

Spontaneous Combustion

is one of the most interesting of phenomena. Vegetable oils, and especially spirits of turpentine, tcnd to take oxygen rapidly from the air, and thus generate heat. The large extent of surface exposed to the air promotes this oxidation, and the rags, being poor conductors of heat, retain the heat produced by oxidation, and hence arises the danger of spontaneous combustion. The danger is increased if the rags are moist. Similar instances of spontaneous combustion are seen in hay mows when the hay has been put up damp. The danger is greater where the rags are soiled by vegetable oils, for example, linseed and cotton-seed oil, and especially spirits of turpentine used in making varnish. One day a scientist who had been investigating the causes of spontaneous combustion saw a man rush out from his planing mill with a box of smoking sawdust in his hands which burst into flames when thrown upon the road. A painter had rubbed the paint from his hands with the sawdust in the box, and departcd unconscious of danger. Within 15 minutes the oil of this paint, thus spread over a large surface of sawdust, was smoking and just ready to break into flame. The danger from spontancous combustion is increased where a quantity of greased rags are left in a pile so loosely placed as to allow a free access of air, yet so compact as to keep in the heat caused by oxidation. Thc mineral oils are much less liable to spontaneous combustion than vegetable oils.

The Sociability of Spiders

has been much questioned, particularly by Dr. M'Cook, in a recently read paper before the British Association. He stated that "while there was association amongst spiders in babyhood, it disappeared in adult life, when the habit of the animal was to dwell upon its snare alone, and pursue its prey alone." This view is contradicted in one respect by Mr. A. Syme, of Perth, who affords the following interesting illustration. "In a tool house here the spiders seem to have had full liberty, so that on one window pane about 18 inches by 9 inches there was a spider's web in each corner, with threads partly over the pane. Onc day I happened to be in this tool-house, and was attracted to the window by a loud buzzing, and on looking found that a wasp had been caught by the spider's threads at the centre of the pane. Each spider stood on the watch, and one after the other rushed out and stung the wasp, running back quickly to their snares, the wasp meantime making a fearful noise and fighting for liberty. The spiders kept running out and stinging the wasp several times, until the wasp seemed to get sick, when the last spider got hold of it by the wing, and after a determined struggle, and giving the wasp a sting or two, it pulled the wasp right into its web. The other spiders retired to their snares, and when I left had not claimed their share of the spoil, but they may have done so afterwards." This little incident at least goes to prove that spiders can unite against the common enemy and does not leave them quite so selfish as Dr M'Cook would have us believe.

The Theory of Thought Transference

recently advanced by Professor Houston in these columns literally astonished the whole of the thinking world by its ingenuity, but the professor's theory has apparently an even more advanced supporter than himself in Professor Lombroso, the learned psychologist. He has been attending some spiritualistic *séances* given by Madame Eusapia, who performs the most remarkable experiments even in broad daylight.

These Remarkable Feats

do not, however, astonish Professor Lombroso who writes that he sees nothing inadmissible. in the supposition that, with hysterical or hypnotic subjects, the exciting of certain centres should produce a transmission of force. He admits that the external sensitiveness has left the body, without, however, being destroyed. In this assertion he is supported by Colonel de Rochas d'Aiglun, Administrator of the Ecole Polytechnique. That gentleman, struck by the fact that the sensitiveness of a magnetised subject disappears from the skin, has sought to discover to what place it is transported. He has, he says, found it all round at a very short distance from the body. The magnetised subject feels nothing when a person pinches him or her, but if anyone pinches in the air at a few centimetres from the skin, the subject feels pain. Though this zone of sensitiveness is generally close to the body, the colonel has found it with certain subjects at a distance of several yards from it. "Light : more light," we exclaim, and we feel that the thinking public will eagerly thirst for further revelations about the truth of what is a distinctly novel theory of transmission of force, before which even the feats of the Comte de Monte Christo would pale. Some further details appear in another column.

GLEANINGS OF THE GLOBE.

THE first horse railroad was built in 1826.

THE electrotype was the work of Spencer, 1837.

COAL oil was first used as an illuminant in 1826.

ICE was first made by machinery by Carre in 1860.

A HIPPOMETER, invented by a French officer, will measure the paces and ground covered by a horse.

A RACE of pigmy camels is said to exist in Persia, which are reputed to be but 25 inches high and weigh but 50 pounds.

NEVER expose feather beds to the sun. Air them thoroughly on a windy day in a cool place. The sun drawsthe oil and gives the feathers a rancid smell.

CLOVER tea is admirable for purifying the blood, for removing pimples and whitening the complexion, and has also good repute as a sleep inducing draught.

PRINCE FERDINAND of Bulgaria is deeply interested in ornithology, and devotes much time to the pursuit of that science. He is a member of the Ornithological Society of Vienna.

A LAKE has just been discovered in Africa by Dr. Baumann, which, he says, is 90 miles long. The lake—Eiassi of the natives—lies on the plateau south-east of Victoria Nyanza. Though about from 18 to 20 miles in breadth, no outlet is yet reported.

IT has been computed, as an illustration of the cheapening of ocean freights, that a half note-sheet will develop sufficient power, when burned in connection with the triple-expansion engine, to carry a ton a mile in an Atlantic steamer.

THE most beautiful crabs in the world are procured in the neighbourhood of the Farallone Islands, off the Pacific coast. They are called "red rock crabs," and specimens sometimes sell in the markets of San Francisco for from £1 to £2 each, merely for curiosities.

AN ingenious device has been invented for turning on the currents for electric lamps at a certain hour. An ordinary clock is so adjusted that at the desired moment a spring is released, permitting a pair of pivoted contacts to fall into mercury cups, thus completing the circuit.

THE cramping of the hand from constant use of a pen can always be prevented by enlarging the holder. Some men prefer to wrap string round the wood, but the best holder is made by getting a bit of rubber tubing at the nearest rubber store and running the handle of the pen through it. It enlarges the holder to the requisite size, and furnishes a soft easy grasp which cannot possibly distress the muscles by any amount of use.

THE spectroscope has been made to discriminate between luminous and non-luminous radiant heat, with important practical results. For example, candle, oil-lamp and gas-jet give 98 per cent. of heat to only 2 of light. The numbers for arc light are 90 and 10, for magnesium 85 and 15, sunlight 70 and 30, and the Cuban firefly 1 and 99. A great problem is to alter the proportions 98 and 2, and 90 and 10, and get as near the firefly's as possible—more light with less heat.

A DECIDEDLY novel instrument of warfare is announced from Rome. The Ordnance department of Italy has been offered for purchase a projectile which, on being shot from a cannon and striking an object, will produce a luminous disc of 100,000 candle-power, and thereby expose to view an enemy's position by night at a distance of from 3 or 4 miles. There will, at rare intervals, be a limited use for such an illuminating bomb, but it will not bring about a revolution in warfare.

ENGINEERS judge of the condition of their machinery by the tone it gives out while running. Every engine, whether stationary or locomotive, has a particular tone of its own; the engineer becomes accustomed to that, and any departure from it at once excites a suspicion that all is not right. The engineer may not know what is the matter, he may have no ear for music, but the change in tone of his machine will be instantly perceptible, will be instantly recognised, and will start him on an immediate investigation.

IN connection with the equipment for fire protection of wood-working establishments it is recommended that a gallon pail filled with fine sand be always placed within convenient reach of each workman employed where oiling and finishing is being done. This practice might well be followed wherever there is a possibility of fire starting in oils or oil-soaked materials. There is nothing which will squelch an oil-fed fire in its incipiency more quickly and effectually than sand—and there are no afterclaps in the way of water damage.

IN dry air at 92° sound travels 1142 feet per second, or about 775 miles per hour; in water 4,900 feet per second; in iron 17,500 feet; in copper 10,378 feet, and in wood from 12,000 to 16.000 feet per second. A bell heard at a distance of 45,000 feet in water could be heard only 656 feet in the air out of the water. The barking of dogs on the earth can be heard in a balloon at an elevation of four miles. On a still day the report of a rifle can be heard at 5,300 yards. The fire of the English on landing in Egypt was distinctly heard 130 miles.

THE late Duke of Devonshire had some claims to be regarded as a hereditary scientist. Cavendish, the discoverer of oxygen, belonged to the family, and an ancestor who flourished in the reign of Richard II. held the office of Chancellor of the University of Cambridge. The late duke was honoured in the same way, and at the time when he was installed he presented to the university what is known as the Cavendish laboratory. He was also connected with the Owens College, of Manchester, and the Yorkshire College of Science. He manifested at least a disposition to promote science. The present Duke is also Chancellor of Cambridge.

DAYLIGHT!

WHAT IS DAYLIGHT?

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not satisfactorily replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 45.

193.—How does light act in producing photographic pictures?

The action of the light is to shake to pieces very lovely constituted chemical molecules. Ordinary photographic printing paper affords apparently the simplest instance of such a sensitive material. The sensitive molecules consist, in this case, of a combination of silver and chlorine that is dissociated under the influence of light—a considerable proportion of the chlorine being liberated. The action of the actinic rays is essentially similar in those cases where the altered compound is colourless, and the application of other chemicals is necessary in order to develop a visible image. In nearly every case light causes decomposition in the sensitive compound.

194.—Since the sun is in motion towards Hercules, how is it that the earth is not left behind?

The solar system may be regarded as exemplifying on a large scale the behaviour of excessively minute particles in a whirling stick or quoit thrown in the air. The ultimate particles in this case are often, if not always, separated from one another by a finite space; but they are held together, within certain limits, by lines of force probably similar in kind to those which hold together sun and planets. The solar system is, therefore, comparable with a solid body, inasmuch as it would fall to pieces if the "lines of force" or mutual gravitation existing between the component parts were done away with. So long as this mutual action is maintained, the motion of our system cannot be affected in one part without being similarly affected in every part. In fact, the earth, or any other planet, behaves to the sun like a stone while it is revolved in a sling does to the hand by which its movement is controlled. The only difference is in the substitution for gravity acting between distant masses, of gravity, *i.e.* cohesion, acting between the particles of which the string is built up. If the solar system is advancing towards Hercules by reason of gravitational attraction, this attraction will exert itself, as the earth's gravitation does upon large and small stones, upon the sun and upon the earth with the same effect. If, on the other hand, the solar system has been in some way projected through space in the direction in which it is now moving, the velocity originally impressed on every part of it must have been equal, and since the resistance of the ethereal medium is practically nothing, all these parts, large and small, continue to travel through space with the same average velocity.

195.—How are cheques protected against forgery?

Two methods are in use principally—the chemical and the physical. In the one alternate narrow strips of the paper are saturated with chemicals, which give rise to a coloured precipitate when they are brought into solution together. On the application of water, with the object of dissolving or washing out writing ink, the chemicals in the adjacent layers or portions of the paper are at once dissolved, and the paper is permanently discoloured by the resulting precipitate. The other process is to nearly cover the surface of the paper, by means of a spraying machine, with little spots of a soluble varnish, such as gum. Over the sprayed surface a design in the form of a delicate tracery is printed. The result is that on the application of water the spots of gum enter into solution, and the continuity of the design is at once destroyed. This last process is also used for the protection of account books and other documents against erasures or alterations.

196.—In what direction is it most probable that the present methods of producing power will be modified during the next century?

The most promising suggestion lies in this direction indicated by Sir Wm. Siemens:—That coal should be converted into coke, or other smokeless fuel, at the mouth of the pit where it is mined; that the gases and the heat evolved should be applied to the production of power, and that this power should be distributed by electrical methods. The liquid and gaseous products of the distillation of coal are undoubtedly better suited to the production of power economically than the crude fuel itself. But considerable improvements in electrical engineering are needed before electrical transmission can be applied with economy in this way. Most important factors in the industrial progress of the next century will be the production of cheap oxygen and the improvement of the gas engine. Progress will certainly not be monopolised, as some seem to imagine, by the science of electricity. And it may be hoped that the introduction of small and noiseless domestic gas engines will supplement the more radical change in the production of motive power that has been referred to.

197.—What is the principle of the kaleidoscope?

It depends upon the symmetrical distribution of images obtained by mirrors inclined to one another at any angle which is an aliquot part of four right angles or 360°. The usual construction is a tube containing two or three plane mirrors, extending along its whole length, and inclined to one another at an angle of 60°. One end of the tube is closed by an opaque screen, having a central hole through which the observer looks in. At the other end are two plates—one of ground and the other of clear glass (the latter next the eye). Lying loosely between these plates are a number of little pieces of coloured glass. The coloured objects, together with their multiferous and symmetrically arranged images in the mirrors, form regular patterns of great beauty, which can be varied by shaking the instrument so as to cause the pieces of coloured glass in the cell to change their relative positions.

198.—What is the rationale of bleaching?

The application of bleaching powder is really a process of oxidation of the colouring matter in the cloth, etc., under treatment. The cloth is soaked in a solution of bleaching powder, which is chloride of lime, and is then dipped in very weak acid. The acid combines with the lime, and liberates chlorine. This chlorine being in the *nascent* or most active state, decomposes the water with which it comes in contact—assimilates the hydrogen with production of hydrochloric acid, and liberates the oxygen which, as everyone knows, is the other constituent of water. The oxygen atoms are also liberated in the active state, and they come in contact with the colouring matter before sufficient time has elapsed for the combinations of the oxygen atoms

among themselves to reduce the *nascent* chemical activity of the gas. The resulting combination of the oxygen with the colouring matter yields a white or colourless compound.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

205.—What is the explanation of the explosion of gunpowder?

206.—What is the connection between the trade winds and the rotation of the earth?

207.—What are Purkenje's figures?

208.—How can arsenic be detected in wall paper?

209.—What proportion of impurity gives water a perceptible taste?

210.—What magnifying power is requisite to discover animalculæ in ordinary drinking water?

DAYLIGHT! WHAT IS DAYLIGHT?

MORE BRAINY ANTS.

Our story about a brainy ant and its hard-earned meal that appeared in a recent issue was found very interesting by numerous correspondents, but it is by no means unparalleled. The lives of these intelligent little creatures abound with wise and singular customs. There is, for instance, the curious habit which ants have of harbouring in their nests a variety of other insects. The reason for this singular exercise of hospitality is by no means always apparent; in some cases, however, it does appear to be fairly clear, particularly in the case of certain mites (Gamasids), whose habits and customs are treated of by Mr. A. D. Michael in the recently published part of the *Proceedings* of the Zoological Society of London. Mr. Michael investigated a number of ants' nests in Corsica and in the neighbourhood of Innsbruck, and in many of these nests there occurred various species of Gamasids, whose relation to their host formed the subject of the inquiry dealt with in the paper. The nests of a small yellow ant, *Tetramorium cæspitosum* var. *meridionale*, were infested with two kinds of Gamasids. One species, which Mr. Michael describes as new, under the name of *Lælaps equitans*, was not only found in the nests, but also upon the ants themselves; and, when the nests were disturbed, the mites, being slow of foot, leaped on to the head of a passing ant, and were borne off to a place of safety. The ants appeared to have not the slightest objection to this familiarity on the part of their guests; on the contrary, indeed, for they carried off the mites without making the least attempt to dislodge their riders, and ants are not as a rule the most peacefully disposed of animals. In the case of another species of ant, the care taken of the Gamasids was even more remarkable. When danger threatened the colony, the ants carried off both the mites and their young, just as they carry off their own young. After a careful series of experiments, Mr. Michael comes to the conclusion that the mites repay the hospitality shown to them by removing the bodies of deceased ants, which they utilise as food.

If you have an idea for a patent, write to the Editor of SCIENCE SIFTINGS, giving the outline of your scheme. The communications will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

HOW AND WHY QUACKS PROSPER.

We have received the following interesting communication:—

"It is not generally known that in England alone of all civilised countries, anyone is free to practise medicine without let or hindrance. That is as long as he does not assume any title implying the possession of a diploma, and does not supply medicine. If he does the latter, he is technically practising as an apothecary, and as such can be legally pursued. But if he simply limits himself to the giving of advice, he is perfectly at liberty to do so, if any one can be induced to consult him, subject to the slight disadvantage that he cannot sign a death certificate in case anything goes wrong. But that need not trouble him, as by confining his attention to subjects like hernia curing or medical electricity, he will never need to give one. And he has the very great advantage over his properly qualified brother, that he can adventure as much as he pleases, with no one to say him nay.

"The poor competitor, the man with a diploma, who has spent at least five years of hard work in a hospital, passed several severe examinations, and at a cost of some hundreds of pounds secured a diploma, is thus at a great disadvantage in the struggle for patients, *as he may not advertise* in any way. If he does, he is struck off the rolls. There is no protection for him. He has to stand with his arms folded and see his patients attracted away from him by the advertising charlatan. Remember that every hernia case treated by the advertising, self-styled hernia specialist means so many guineas or shillings out of the pocket of some properly qualified medical man.

"It has been estimated, with what truth I know not, that Harness spends £25,000 per year in advertising, and that the profits are another £25,000.* If this be so, here we have £50,000 taken away from the qualified medical men in England, who are just so much poorer, as the cases would have come under their treatment, if they had not been attracted away by the specious advertisements of the Electric Battery Company.

"There is, I believe, only one remedy for this state of things. That is, to pass a short bill through Parliament making it illegal for anyone who does not possess a diploma to give medical or surgical advice, or to practise any department or speciality of the healing art. It is only what the medical profession have a right to demand in the way of protection. But who will do it?

"I may add, as showing how people are led by advertisements, that it is quite the exception for me to find, out of the numbers of patients who come under my care for various forms of nerve exhaustion, one who is not wearing, or has not tried one of Harness's electropathic belts. And, as showing the real value of the appliances, it is equally rare for me to find one who even fancies that he has received any benefit from it.

M.D.Lond.

[We believe these figures have been underestimated by our correspondent.—ED. *S. S.*]

VOLUME I. OF "SCIENCE SIFTINGS"
CAN BE HAD
Bound in Cloth and Gold, 3s. 6d. Postage 6d. extra.
Or from Messrs. W. H. Smith & Son,
and through any Newsagent.

THE RISE FROM BRUTE TO MAN.

Though still one of the least mature of the sciences, "one of the younger daughters of human knowledge," as it has well been termed, anthropology is already divided into four branches of inquiry, having very diverse fields of action and calling for study from those whose special trainings differ widely. These are archæology, mythology, philology, and comparative anatomy. These have been the offspring of the parent science for varying periods, having their origin in the order here given. The first three, depending upon external records, have, quite naturally, been given preference in time past; they have attracted to themselves many more investigators, by reason of both the much greater ease of obtaining the material upon which they are based, and because of the fact that they call for far less special training than does the last named, though this is less true of philology than the others.

While the very essential work that falls to these three cannot be overlooked—the work of archæology, with its entrancing studies of the relics of long-forgotten races; the research of mythology, with its fascinating inquiries into comparative religions and the dawn of philosophies; and the delving of philology, whereby we are brought into touch with the early struggle of man to be understood by his fellows—while these may and will not be overlooked, still to the less attractive branch of research which comes within the pale of anatomy, with its comparisons of bone and sinew, muscle and nerve fibre, as they exist in man to-day, and as they existed in his ancestors, near and remote, must be accorded a very prominent part in solving the problems which are yet stumbling-blocks in the progress of the science; for by its aid we are able to read with an ever-increasing degree of exactitude Nature's sign-manual, whereby she has left an indelible record of the upward struggle from *monera* to man. Not content with supplying us with a record of man's advance from early prehistoric times, such as are its sister sciences, by this department of inquiry, we are taken back to a period long before he became

> "A creature who not prone
> And brute as other creatures, but endued
> With sanctity of reason, might erect
> His stature, and upright with front serene
> Govern the rest, self-knowing.'

Among the many interesting problems encountered by the searcher after facts in this field of inquiry, none appears to be more pregnant with suggestion than those which have to do with what might be termed man's struggle towards the upright posture. In that battle he has not always been entirely the victor; even yet he is not completely master of the situation, and he carries many scars which speak plainly of a constant warfare between an aspiring mind and a grovelling body. A few of the more striking of these signs we wish to briefly discuss here, bringing together into one compass some facts based on researches that are to be found scattered throughout the vast and rapidly-growing literature of the medical and kindred sciences.

The effects of the laws governing the transmission of individual adaptations from parent to offspring are now familiar to us, though the actions of those laws are as yet most imperfectly understood. One of the best-known results of these laws is that certain influences long acting in a uniform manner on many successive generations become cumulative, and marked permanent differentiation in structure is the outcome. But, as is well known, Nature is never content with her work; the adaptations of seemingly the greatest value to-day are the disused quantities to-morrow. Such, so soon as they are relegated to the realm of the *inutile*, become aborted or atrophied, and their place is taken by structures of greater value to the human organism. Yet this period of atrophy is most gradual in its progress; this regression covers a time not only many generations in duration, but in many instances it has, as we have good reason to believe, its origin in an era far antedating that epoch when man first became a factor in creation. It is from these atrophied parts, these vestigial parts of the human animal, that we glean a history of the struggle along that pathway by which humanity has climbed from darkness to light, from bestiality to civilisation—relics of countless ages of struggle, often fierce, bloody, and pitiless.

All are familiar with the old illustration of this principle, that of the blacksmith who, famed for the great prowess of his good right arm, having been prevailed upon to allow it to be tied in one position across his breast, and there kept for a period of three months, at the expiration of that time found himself unable to remove it from its long accustomed place when released. The corresponding waste of muscular tissue whereby the trained athlete of the summer time soon relapses into the soft and flabby clerk or student of the winter, if blood supply and use be not maintained, also illustrates how rapid are the first effects of this sort of waste. This applies as well to bone and cartilage as it does to muscular tissue; a high quality of such tissue will soon be replaced with that of an inferior sort, though much more easily maintained on account of its less metabolic nature, *i.e.*, its greater freedom from a tendency towards rapid change, calling for continual upbuilding.

Long-continued research, given its initial impulse by Lamarck early in this century, shows that the cells composing living tissue are undergoing continual change, each impulse from without being registered by some small alteration in their physical condition. Even structures of the most permanent sort are thus modified in time; muscular tension or pull thus in time alters the form of bony structure quite as markedly as wear shapes the enamel-covered teeth or undue weight or pressure curves the spine. All of these qualities have aided in the recording of the successive steps whereby the erect position has been very gradually acquired by man. They speak quite as plainly of the comparatively recent acquirement of this ability as do the efforts in this direction which lead finally to that power in the creeping child. The young chick comes forth firm of limb and steady of gait; the human infant is but little better than a helpless grub.

Parallel to this separation in vertebrates is that in the widely differentiated orders—*Hymenoptera* and *Othoptera*—in the *Arthropoda*, wherein the young of the bee is a helpless, soft grub, incapable of locomotion, and requiring to be fed by his adult sisters; while the young grasshopper emerges from the egg in form closely allied to the parent, and self-reliant and aggressive. In both man and bee we recognise the late acquirement of self-reliance and the full powers of locomotion as indicative of a higher final status in the animal scale, and as pointing to the fact that these powers have for long been of less value and lower rank in preceding generations. Naturally, if this be the fact, we shall have no trouble in finding unmistakable indication of it within the human structure. And this we find upon a very cursory examination is the case. Thus we will at once discover that the human vascular system, like that of our four-footed distant relatives, is best adapted for quadrupedal

locomotion. This is well illustrated by the difficulty which is experienced by the hunter in seriously wounding a bear. Let the animal remain on all fours, and it is hardly possible to wound a vessel of any size, whereas if he assnme the erect position he will, as is the case with man, leave exposed a number of most vulnerable points but a short distance under the surface. For a clearer understanding of these facts, however, it will be well to take a view of some of the most remarkable of them in anatomical order, beginning with the head.

One of the most unmistakable signs of the change from the quadruped to the biped to be found in our system is in the relics still existing in us of the *ligamentum nuchæ*, the extensive, powerful, elastic strap which passes from the occipital region of the head to the thoracic vertebræ, and sends filamentous processes to the neck vertebræ. This system of ligaments is required in the quadruped to bear the weight of the head and relieve the spine of undue strain. The equipoise of the head in humans and in the anthropoid apes is such that this is no longer of much value in the erect position, yet unmistakable "ruins" of this vast structure, in the shape of facial bands, are still to be easily found in the neck, though, naturally, they are much more atrophied in man than in the gorilla and his congeners.

The marked changes in the facial angles from the ultra-prognathism of the orang-outang to that of civilised man are also mainly attributable to the assumption of the permanently upright position. As the weight of the head with its growing cranial capacity increased, the lower jaw has been forced under it and nearer the spine, to aid in maintaining a better balance, and thus has resulted that decrease in the size of the under jaw which is the main characteristic of the civilised countenance. So, while in one case we find that primitive man, nearer the four-footed brute in his organisation, possesses in his head an effective apparatus for strife—jaws, teeth, and the powerful muscles for using them—on the other hand, the *fin de siécle* product of civilisation is possessed of a cranium structurally subordinated to the needs of a creature to whom the possession of an untrammelled brain is the primary requisite.

This change in cranial balance has produced some marked differences. Important among these may be mentioned the crowding of the last molar or "wisdom tooth" back against the ascending curve of the jaw in such a way that its "cutting" has become a useless reminder of the period when that tooth was of value, and not so evanescent as at present. In fact, it is now no uncommon thing in the experience of dentists to find patients who have never cut these teeth. There is a very evident intention now manifest on Nature's part to eliminate them from our system. Some of our Australasian cousins show an occasional fourth molar or second wisdom tooth, and there is evidence that an incisor has disappeared from the upper jaw in man. The reappearance of the enlarged canines or "dog teeth" in low-type heads is not uncommon, and the muscle that lifts the upper lip from these and bares it for use, which is so prominent in certain *carnivores*, frequently reappears. It is this muscle, as pointed out by Darwin in his "Descent of Man," that produces the dog-like snarling and the disdainful expressions in which some men excel.

It will readily be appreciated that the sense of smell cannot be nearly so necessary to a biped as to a quadruped, especially as while attaining the erect position he has also acquired the ability to cook his food, and otherwise so prepare it for safe consumption, that smell is not so constantly brought into play as a means of guarding against the introduction of unsafe food into the stomach. Consequently, we are prepared to find olfactory bulbs in the fœtal brain that indicate a recent degeneration of that sense, and that the lower races as well as the man-like apes are better provided in that respect than are we. The third eyelid, common to birds and lizards, and useful to them in preventing the entrance of foreign substances into that organ, exists in a very rudimentary condition in man. Around the human ear are yet vestiges of a muscular system only adapted to wagging or moving it; occasionally a person will be found who will exhibit this power in a modified degree with much pride. Its derivation from ancestors so far down the mammalian scale should rob this rare accomplishment of its assumed credit. There now resides a lady in Philadelphia, a member of some of its learned societies, who, in addition to this power over her ears, has the semi-simian, pointed ears described and figured by Darwin, and has cut and retained an unusually large and perfect set of third molars; physically she is thus seen to be a partial reversion to an earlier type, though intellectually she belongs to the advanced ranks of her sex.

(*To be concluded next week.*)

DAYLIGHT!

CARING FOR THE MICROSCOPE.

Besides acquiring the ability to properly use an instrument with its accessories, it is important to know how to keep one in the best working condition. It may be said without reserve that an instrument properly made at the outset and judiciously used should hardly show any signs of wear, either in appearance or in its working parts, even after the most protracted use; and further than this, every good instrument should have a provision for taking up lost motion, if there is a likelihood that this may occur in any of the parts.

Especial care should be given to the optical parts—in fact, such care that they will remain in as good condition as when first received. Accidental injury may, of course, occur to them, but if a systematic manner of working is followed, and a special receptacle for each part is provided, this may usually be avoided.

To Take Care of a Stand.—One of the first rules should be to keep the instrument free from dust. If dust settles on any part of the instrument, remove it first with a camel's-hair brush, and then wipe carefully with a chamois skin, *with* the grain of the finish and not across it, as in the latter case it is likely to cause scratches. Keep the working and sliding parts absolutely free from dust, as this grinds, and will thus soon cause play.

Use no alcohol on any part of the instrument, as it will remove the lacquer. As the latter is for the purpose of preventing oxidation of the metals, it is important to observe this rule.

In using the draw-tube impart a spiral motion. In instruments which have no cloth lining, a straight up-and-down movement should be employed, as the tube will otherwise become scratched. If it becomes necessary to lubricate any of the parts, use a slight quantity of soft tallow or good clock oil.

In an instrument which is in constant use it sometimes occurs that the pinion works loose, and occasionally to such

an extent that the body drops of its own weight. Tightening screws are usually provided to take up the play.

In using a screw-driver, grind its two large surfaces so that they are parallel and not wedge-like shape, and so it will exactly fit in the slot of the screw-head.

In inclining the stand *always* grasp it at the arm and *never* at the tube, as in the latter case it may loosen the slide or tear off some of the parts.

When repairs or alterations are necessary, always have these made by the manufacturers; they can, from the system of duplicated parts, not only do it cheapest, but best.

To Take Care of Objectives and Eyepieces.—It is as necessary to keep these free from dust as the stand—in fact, even greater cleanliness should be observed. When indistinct, dark specks show in the field, the cause may usually be looked for in the field lens, although sometimes in the eye lens also. The dust may be removed by a camel's hair brush, but when this is not sufficient use a well-washed piece of linen, such as an old handkerchief. From its fine texture chamois skin is desirable, but as it is fatty it should never be used until after it has been well washed.

The same method applies to cleaning objectives. Clean an immersion objective invariably after it has been used, first by removing the fluid by a moist linen, and then by using a dry piece. Keep the objectives especially in a place where they are not subject to extreme and sudden change of temperature, as the unequal expansion and contraction of glass and metal may cause the cement between the lenses to crack. Also keep them from direct sunlight.

Screw them into the nosepiece and unscrew by grasping the milled edge.

Avoid any violent contact of the front lens with the cover glass. Usually the latter suffers, but it is as liable to occur to the former.

Above all, it should be made a rule that no one but the owner handle the microscope and accessories. One person may be expert in the manipulation of one instrument and still find it difficult to work with another.

The fine adjustment particularly causes the greatest difficulty, as in some instruments it corresponds with the movement of the micrometer screw, while in others it is contrary, and thus the objective as well as object are endangered.

THE POWER OF LIGHTNING.

On August 1, 1846, St. George's Church, Leicester, which was a new building, was entirely destroyed during a thunderstorm. The steeple having been burst asunder, parts of it were blown to a distance of thirty feet in every direction, while the vane rod and top part of the spire fell perpendicularly down, carrying with them every floor in the tower, the bells and the works of the clock. The falling mass was not arrested until it arrived on the ground, under which was a strong brick arch, and this also was broken by the blow. The gutters and ridge covering were torn up, and the pipes used to convey the water from the roof were blown to pieces. Mr. Highton calculated the power developed in the discharge of the lightning which destroyed this church, with some known mechanical force. He discovered that a hundred tons of stone were blown down a distance of thirty feet in three seconds, and consequently a 12,220 horse power engine would have been required to resist the efforts of this single flash.

WHAT WE HAVE LEARNT ABOUT MARS.

The knowledge we have gleaned from the present opposition of Mars—for it will continue to shine for several months overhead—is by no means extensive, and may be characterised as chiefly confirmatory of former observations. M. Camille Flammarion, the great astronomer, writes from Paris as follows:—"A short and altogether senseless paragraph, concocted by some ignoramus, has recently appeared in the newspapers, stating that the observations now being made of Mars have not shown enigmatic lines to which the name canal has been given, and that their alleged formation are only fads of an Italian astronomer. It is a pity that such gross idiotic observations, which display a want of even common courtesy towards one of the most eminent astronomers of modern times, should have been laid before some millions of readers when the truth is exactly the opposite. In spite of the low position of the planet with regard to our horizon, and consequent difficulty in making observations certain, a number of these canals have been clearly defined, even at the observatory of Juvisy, whose equatorial is of very moderate dimensions—9.15 inches—but whose observers are zealous, ardent, and laborious.

"I have been especially occupied measuring the diameter of Mars and of Cape. As regards the canals, I have only been able to recognise personally the presence of Nasmyth, Indus, and Ganges. The diameter of Mars I have ascertained to be 9″ 39‴, instead of 11″ 10‴, the measurement adopted by Leverrier. We learn that the canals—those already named, or others—have been seen by other observers, notably through the enormous magnificent equatorial at Mount Hamilton, U.S.A. Astronomers are not agreed as to the nature of these strange formations. That the continents of Mars are crossed by a network of lines often perfectly straight, and of geometrical aspect, is undoubted by all who have studied the question, but it is difficult to decide what is the origin of these tracings. The mouths of the principal ones seem to be those of former rivers; nevertheless, they are not real rivers, because they do not have their origin in shut-in land, but run direct from one sea to another, and, further, because they cross each other. This leads to the conclusion that they are watercourses on some level flat ground. Now it has been found that the effects of time on the orographic surface of the continents of Mars, which is older than the earth, is to flatten them. It is probable that from 4,000,000 or 5,000,000 of years hence all the land on the earth will be levelled.

"On the other hand, it is probable they are water, because they are the same colour as seas of Mars; because they communicate with seas, and because they change in width and even in position, and they for that reason are full of water. Certainly, there is nothing to prove it. Is their vegetation tender? Perhaps so. Science does not forbid the supposition that the inhabitants of Mars were able to change the courses of the old rivers, with the view of making a general distribution of water, which had already become scarce, but in places threatening the surface of the continent flattened by the wear and tear of ages. This is one hypothesis. It is not opposed to science and the geometric and intentional appearance of this network of lines warrants it. It is to be feared that it will be only possible to explain the canals of Mars by leaving out of sight the possibility of an identical rectification of watercourses, any more than the astronomers of Venus could explain our railway systems, if they persisted in refusing to admit of any other influences

affecting the surface of the earth than blind forces of Nature. We cannot say this is. We can only say this might be, and should any better explanation of the things that have been observed on Mars be forthcoming, we are quite prepared to accept it, above being only provisional, until it appears that it is beyond doubt."

It has been observed that at certain seasons the canals have been seen doubled, formed of two parallel lines. This extraordinary phenomenon was first observed in 1881, and will probably not be seen this year, because it only occurs in the spring and autumn of Mars—that is to say, during equinoxes, and not in summer, and because the inhabitants of Mars are approaching their solstice. But whether they may be seen or not this year, they exist. It is more difficult to explain them than even the canals. May they not be due to some atmospheric refraction caused by crystals, such as ice, as happens with us, producing halos and parhelias resembling more or less double refraction of the spath of Iceland. However it may be in regard to existing problems set by our neighbouring planet, we may state that Mars, of all planets in our system, is most interesting, through its resemblances and differences from our earthly habitation. We can only repeat what Herschel said more than a century ago: "Its inhabitants probably enjoy a situation in many respects similar to ours." Novelty has always been a special attraction for us. This is the first time since the origin of mankind that we have discovered in the skies a new world sufficiently like our own to awaken our sympathies. Many years will doubtless pass before science is able to acquire ideas as complete respecting our other neighbour planet, Venus, as those we now possess respecting this world of Mars. But what wonders has not science of the future in store for our successors, and who shall dare say that mankind on Mars and mankind of this earth will not one day be able to communicate one with the other? Generations will pass away, and progress will long continue its upward way.

Proctor says, however, that the oldest planets are those nearest the sun, and, if that is true, we may look in vain for intelligent inhabitants on Mars, since that world would be many millions of years younger than ours. His theory that the moon is a dead planet because it possesses no atmosphere is, however, overthrown by the fact that considerably more than half her surface is illuminated, as may be seen immediately after her conjunction or "new moon," when a ring of light compasses her globe. This could only be due to the refracting power of an atmosphere. But as the moon is our secondary, and owes her existence to our planet, she must be many thousand years younger than the earth. Now, if evidence can be produced that the planet Mars, on the contrary, is older than ours, we may safely conclude that it is inhabited with intelligent beings, wiser perhaps than we are because older as a race, and that in the greatest probability they displayed signals recently to ascertain whether or not our planet, too, is peopled with intelligent beings.

The earth is approaching the sun, but of this he furnishes no evidence. In 1889 it was pointed out that our tropical year being shorter than sidereal, as seen by the procession of the equinoxes, proves to a demonstration that the earth is shifting its position in relation to the sun. The second point, and it is a proof that is decisive, is the moon's circular acceleration, by which we mean that our satellite is now travelling faster in her orbit than she did in the days of Hiparchus, and that this acceleration is constant. When the earth is approaching the sun, as she is when moving to her perihelion, our moon recedes from us, and travels in a much larger orbit, and when our primary approaches her aphelion, our satellite approaches the earth, and, of course, moves faster because in a smaller orbit. It is plain. therefore, that if the moon is constantly increasing her orbital, it can only be caused by the earth's recession from the sun.

This is a sound scientific fact, and ought to silence for ever the evil genius of those astronomers who every now and then predict that our world is about to fall into the sun. But if the earth is receding from the sun, is it not lawful to conclude that Mars is also? And as Mars is the next planet to the sun beyond ours, must he not have begun his recession before ours did? And, if so, must he not be older? And if the younger planet is inhabited by intelligent beings such as we are, and can invent telescopes to examine his surface, how much more perfect must their knowledge be of the physical condition of our sphere? But we can signal the people of Mars much more easily than they can signal us, for we can only see his illuminated hemisphere; that is, when we look at Mars it is always in the daytime, when signals could be detected only with the greatest difficulty, and only in the most powerful telescopes, while, on the contrary, they would have seen only our dark hemisphere in a thin ring of light, where an electric-light signal, or even one by an extraordinary large fire, such as a burning forest, could easily be seen. No doubt, their maps correctly show the locality of all our great active volcanoes. But how would the Martians signal us? Only in two ways—by a light brighter than the sun, or by an enormous black figure stretched on the snow. How remarkable, then, is the information sent us by the Lick observer to the effect that he saw changeable lights on his surface—electric lights, no doubt—and immense changing figures of black on his snowy pole.

WHAT IS DAYLIGHT?

THE SIPHON CLOCK.

A very interesting contrivance that can easily be constructed by an amateur is attracting attention in France. Over the top of two sides supports or side arms, a cross-beam is placed in the shape of a knitting needle, which must be perfectly straight, of course, and connected at one end with a small hour hand that moves around a dial. A tiny pulley swings around the centre of the needle, and in the groove of this pulley runs a thread, to one end of which is attached a float, and to the other end a balance weight. An ordinary candlewick passes from the larger glass into the smaller one by its side.

As soon as the large glass is filled with water, the operation begins, the wick gradually absorbing the water, making the float fall lower and lower, which action determines the movement of the hand on the dial. The clock is easily regulated; if it goes too fast the thickness of the wick must be diminished, if two slow it must be increased. The form and size of the large glass on which the regularity of the clock depends, has been determined by M. Pellatt, of the Faculty of Sciences in Paris, but with a little careful study even an ordinary glass can be made to render good service.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

THE USE OF THEORY.

It is somewhat objected to science that its sphere is limited, as its knowledge is relative; that it presents us with little that is definitely settled as to the character of the world we live in, and knows nothing of its origin or history. We know nothing of the ultimate nature of matter; nothing of the mystery of force, or of the great underlying facts, life and mind, which are as inscrutable to-day as at the dawn of speculation, when the human mind, fascinated by their mystery, first mused upon them.

We have, it is true, a variety of theories on the subject—modifications, for the most part, of what is termed the atomo-mechanical theory, which, starting with the existence of matter and force, and denying the reality of aught beyond, would explain the universe on that hypothesis. To many the assumption that matter and motion will explain everything seems a bold one, in view of our manifold experience; but the difficulty is increased when it is found that the majority of such hypotheses are not, strictly speaking, consistent with themselves, and the opinions of our chief authorities are much divided respecting them. Take, for instance, that hypothetical medium, the ether of space, which so many scientists consider essential in explaining the phenomena of light, heat, etc. It is found to vary in its qualities according to the requirements of the different lines of research, so as to have one set of properties in physics and a contrary set in chemistry. In short, as Maxwell humorously remarks, "ethers enough have been assumed to fill space three or four times over," and "the atom of the mathematician, metaphysician, and physicist have nothing in common but the name."

In chemistry, too, the "atomic theory" has ceased to be regarded by eminent scientists as a real representation of the nature of matter. The later researches by Crookes have split some of the so-called atoms into other elements, and results of spectrum analysis go to show that the greater number of such bodies are susceptible of like division. The existence of the atom, even in the physical sense, is disputed as a thing involving evident contradiction. Indeed, with some thinkers—as Faraday, in whom are found the brightest gleams of insight into physical truth—matter in the ordinary sense seems to disappear altogether, and in its stead we find the singular conception of matter, first enunciated by Boscovich, as simply "points of space endowed with force." "What," asks Faraday, "do we know of the atom apart from its force?" And summing up we may add, What do we know of force? Here the ablest intellect finds a bottomless abyss. There is no image in the human mind corresponding to that reality. We may reason of it as the algebraist reasons about an *X*, or unknown quantity, but we only know it by its effects, and can only infer its existence as their cause.

What, then, it may be said, is the use of speculation, if it ends in uncertainty or contradicts itself? The answer to this is found in that primary instinct of the mind which impels it to seek for a cause wherever an effect is produced, and tends to reduce what is strange and manifold in phenomena to simple and well-known principles; and in the fact that theory, legitimately applied, has been useful as a "working hypothesis," enabling us to interpret the phenomena of the various sciences, and has been especially useful as an instrument of discovery. We may not know that the atom, as Dalton conceived it, has any existence, but a great deal of the phenomena of chemistry occurs just as it must have done if such things existed, each having its particular weight, affinity, etc. Whatever its ultimate validity may be, this hypothesis does much to make the various laws of chemical combination intelligible, and by using it many discoveries have been made. There is, then, a region where the human intellect, weak though it appears amid the stupendous forces of Nature, can yet attain an insight into her workings and a power over phenomena.

If there is a science having for its object the study of the various kinds of matter, and more directly conversant with its powers than any other, it is chemistry. Here, then, if anywhere in physics, will be found a clue to the nature of things; and, in truth, recent generalisation by Crookes and Gruenwald, if sustained by subsequent evidence, certainly furnishes us with startlings views on this matter. We allude to the theory—not entirely new, but now advanced with striking proofs—of the "genesis of the elements," tending to show that the so-called elements are themselves made up of simpler forms of matter, being all of them multiples of one primal element; that what we call difference is quantitative, not qualitative, and that all matter is of the same kind at the bottom. So that the dream of the alchemist, although practically impossible, was in theory correct. Until chemical science had developed, the metals known to man had been such as were also found "native" in Nature, strewn upon the surface or hidden in the recesses of her lower strata. It was reserved for chemistry to strip the disguise from the "Proteus" of matter, and, peering beneath its ever-varying forms, remove, not loads of earth and superincumbent strata, but atom and molecule, to which it was united by intense "affinity"—that subtle force which, although unable to act, except at short distance, exerts such enormous power. Some idea of this power may be obtained when it is considered that the havoc produced lately in a millionaire's office by an explosion of blastful violence was but the result of a handful of chemical atoms trembling on the verge of dissociation.

Numbers of metals hitherto unknown have been recovered from the secret arcana of Nature, and thousands of new compounds produced—as sodium, potassium, magnesium, barium, and aluminium; groups of metals hitherto unknown in Nature, whose existence, at least in the separate state, she may be said to abhor as thoroughly as she "abhors a vacuum," so unfavourable are the conditions for such. Nevertheless, an almost absolute vacuum may be made; and chemists, by arranging artificial conditions and doing like violence to Nature, have succeeded in reducing the above-named metals, beside many others.

THE DELICACY OF VISION.

The delicacy of vision is much greater for lines than for isolated bodies, and particles which cannot be perceived by the unaided vision can readily be distinguished when laid side by side in a row. The smallest particle of white substance that can be distinctly seen on a black ground, or *vice versa*, is one four-hundredth of an inch square, though it is possible to distinguish particles one five hundred and fortieth of an inch square, but with great uncertainty. Substances which strongly reflect light can be seen when their dimensions are much less than indicated by the foregoing figures. A bit of gold leaf one eleven hundred and twenty-fifth of an inch square can be distinguished very easily by an eye of ordinary power.

DAYLIGHT!

STRANGE SCIENTISTS IN PARIS.

Two Parisian medical men, Drs. Dujardin-Beaumetz and Mesnet, have baptised a new science, that of dermography or stigmatism. This science is a plausible explanation of *sigillium giaboli*, the seal of the devil, that in olden times sent so many poor witches to the stake. An historical, philosophical, and religious problem has been solved, for when the demon interfered in all the acts of life the one accused of witchcraft was submitted to a thorough physical examination in order that the mark or stigma might be found. Had the accused been for a long time governed by the demon a wound testified to the fact, but with recent possession swelling and redness of the skin were perceived. No one thought of investigating this phenomenon from a scientific point of view until some time ago. Dr. Dujardin-Beaumetz saw at the St. Antoine Hospital a woman whose skin reddened at the slightest contact, but without any feeling of heat or irritation. With a pencil the doctor produced cabalistic inscriptions on her skin, and so astonished was he that Dr. Mesnet's attention was called to the subject, and now, as we have said, dermography is baptised a science.

Dr. Mesnet says: "If we take a well sharpened pencil and write on the arms, the shoulders, or chest of this woman we see a bright red line follow the pencil immediately. This redness lasts from six to eight hours."

Since the first experiments the doctors have found many new subjects, some suffering from no disease, others who are subject to hysteria. Army doctors are now performing experiments on their soldiers, and it seems that many have skins so impressionable that inscriptions may be read at a distance of 50 feet and during five or six hours.

Dr. Dujardin-Beaumetz is the author of many therapeutical works of great value. He is one of the greatest authorities on hypnotism, and he says "all ills do not find a remedy in this treatment, but many are relieved, and this is a great result."

A society of hypnology has been organised in Paris, with the aim of establishing permanent relations between the various schools of hypnotism. At the first meeting of this society several important questions were studied, among them the relations between hysteria and hypnotism, and between criminal suggestion and penal responsibility. These seances will have great interest for all those who follow contemporary philosophical movements.

Lawyers and magistrates cannot remain indifferent to experiments that place in a new light the limits of penal responsibility, while psychologists will be glad to possess the key to mysteries of the human soul.

The Society of Hypnology will carefully examine and compare the numerous instances presented, and formulate principles, so that hypnotism may become a positive and rational method of treatment. For the moment there is no need of theoretical explanations, but of precise and numerous examples, observed with impartiality analysed with skill and described with the rigorous method of modern scientific investigation.

The director of the Ecole Polytechnique, Col. de Rochas d'Aiglun, has just written a work on hypnotism called "Etats Profonds de l'Hypnose." This work is filled with startling statements, and among them is this one: "To suffer one need not to be touched; that is, suffering may be produced by touching some invisible ray emanating from one's self." The sentence is rather difficult to understand, but Col. de Rochas illustrates it in this way:

The subject is magnetised; sensibility disappears, from the surface of the skin, but reappears farther away. If the subject's flesh be pinched he feels nothing, but if one pinches in space, perhaps several yards from the subject, he feels and suffers. If at this distance one sways the flame of a lighted candle the subject has the sensation of burning. Around his body there is a sensitive layer, entirely distinct from his skin, and this layer crosses all substances. It can pass through walls, so that a subject may be touched in the room where he is not, and receive the sensation in the room where he really is. But one element can conquer this unknown fluid, and that element is water. As the fluids stop at water, according to Col. de Rochas, human sensibility may be collected in a glass, and this experiment he has tried with success. He placed his subject, a young woman, in contact with a glass of water, and throughout an entire evening this water retained its sensibility. If someone drank the water, even if the subject were awake, the woman suffered, and one witness placed his finger in the water two hours after it was vitalised, then held his damp finger near a stove. The woman shrieked as though her flesh were burning.

The glass of water became a part of the woman's life, and all that affected the water affected her.

But what is this sensitive layer? Even Col. de Rochas is not able to explain, but his discoveries have led to many theories among savants. For instance Dr. Baradue has discovered that the Abbe Fortin's magnetometer for measuring the variations of terrestrial magnetism can be used for measuring the variations of animal magnetism. This apparatus is composed of a magnetic needle suspended in space, and this needle oscillates according to the state of the atmosphere. It will also, says Dr. Baradue, oscillate according to the state of the human fluid. The ends of the fingers of the right hand are held 1 inch from the south pole of the needle, and in nearly every case the needle is attracted or repelled; the same result is obtained by presenting the fingers of the left hand to the north pole. With this experiment as a basis, Dr. Baradue has discovered that the results correspond to the muscular force given by the dynamometer. When the right attracts as the left hand repels, it is a sign of perfect equilibrium, of normal, regular tension. If the right attracts more than the left hand repels, it indicates general debility, and if the right hand attracts while the left hand leaves the needle stationary, it means that the subject is absolutely nervose. It is supposed now that physicians will understand by this machine whether they should give their patients electricity or use an opposite treatment, and in this way the human machinery will be perfectly regulated.

As the result of recent researches on the cause of the production of galls upon the leaves of trees, it has been found that these singular excrescences are not capable of being produced by the action of stings, incisions, or the introduction of drops of formic or other acids, nor through the effect of the presence of foreign bodies, or even of the eggs of non-galligenous insects. On the contrary, it has been established that galls develop when certain insects called *galligens* deposit their eggs upon the leaf. There exist two causes of production; one, and the principal of which, is the result of the vesicatory action of a liquid emitted by a special gland, and the other the vivification of bacteria analogous to those cultivated by M. Pasteur.

SOCIAL SCIENCE.

WANTED—A NEW ENTHUSIASM.

The age is a dull one; and dulness is immoral. We do not refer to the revelation of facts, but the revelation of great obligations. Never before did life seem so important to its possessor. He is unwilling to part with it for the old-fashioned obligations of patriotism, philanthropy, friendship. The reason plainly is that every one sees that there is a vast deal to learn, to acquire, and thus to incorporate into himself. Besides, science has shown us that to be a human being is not exactly fulfilled by going to some paradise of rest. We must live, and live by becoming broad and wise.

So we do not look at all complacently on being prodded with a spear or shot at and killed and sent to Valhalla; and, as for being maimed for glory, why, the loss of a leg or an arm has much to do with a man's ability to be a complete man. Yet there is some compensation in the increase of suicides. These do not indicate an enfeebled grip on life; but that, while fewer are willing to rush against a cannon's mouth and find satisfaction in brute-force fighting, there are a good many who fail of reaching ambition's goal—and these, losing hope, go to death by a private road. The number that die by violence is vastly decreased within two centuries; but suicides have somewhat increased.

It is curious that one must turn to such statistics for comfort. But there is more in any set of facts than that which lies on the surface. There is hope in despair. Nothing can be worse than a state of social content. Even the schemes for Utopian reform are pleasant reading; and the fact that thousands are ready to enter into any visionary effort indicates that we are not far from some new revolution of vast importance. Will it come by means of legislation? It hardly seems probable. We have had an era of faith in law-making. Laws are bowled about like snow balls in winter. No lawyer can codify them, no citizen can keep acquainted with them. They run across each other's track. They puzzle the shrewdest lawyers to expound them. There is a slowly awakening conviction that much of the platitude of our age is because we have believed the interests of this world could be intrusted to an average majority, and so we have ceased to create or try to create heroes. Whereas all the great things of time have been done by single men, from Judas Maccabeus down to Cromwell, and all in defiance of law. There is no probability that we shall legislate ourselves into a warm glow or a fiery heat of enthusiasm for great deeds.

But is there not a chance for a new and magnificent enthusiasm in those very social conditions which are most severely condemned? We hear the age spoken of as degenerative because of the vast accumulations of wealth. But wealth may be a power for beneficence, as great brains may be, and we have no more reason for regretting large fortunes than large heads. No doubt to secure a perfect equality of all people we need small heads, and small heads or empty heads go with empty purses. By no other means can you level us. Yet only by great brains can the world move upward and onward; this we perceive clearly. So also by wealth the world has been moved, and will continue to be moved. Can we consecrate money power to humanity, as we do mind power? We do not see why not. And in our judgment any one must be blind who does not feel the change that is going on. It is not legislation that will produce a moral revolution, but a new enthusiasm.

It is a strongly growing sentiment that property is in all cases held by us as "trustees," "You," a well-known social scientist is reported to have observed, "you, who now boast yourselves to be men are, men only because of five hundred millions of antecedent evolution. You are trustees of all nature has wrought in the past." This is the sublime position of a man of brains. So of wealth; it is a trust, and whoever holds it does so as a trustee—responsible in every fibre of his being. Can we foresee a state of society, rapidly developing, in which men shall feel this responsibility and act on it? No, these are not your acres, but you by right of your tact, skill, and power to use wisely, are in possession; nor is this bank vault yours, sir banker! And if you do not recognise your trusteeship your wealth will curse you and yours. The future, holds for us a grand enthusiasm of this sort—a moralisation of property and possession.

We look a little further, and hope glows still more brightly over a conscious uprise, a new factor that we have termed internationalism. This began with trade. Our ships became shuttles, that wove us together across the seas. Literature soon followed. We read each other's thoughts as we bought each other's wares. We learned to think together, and soon Shakspeare and Goethe and Longfellow became universal property—citizens of the world. It did not seem possible that we should have a common political system; or that the heart-throbs of Egypt and England, of America and Japan could accord; it does not seem possible to many as yet. But step after step the ideas of human fraternity have marched onward. SCIENCE SIFTINGS is read around the world. That is the most successful literature which is least local. We feed the starving of Russia; we have an honest share in the labourers' woes in France, Roumania, and America.

If the age be dull, it is not dead. The elements of a mighty enthusiasm are accumulating. We must learn to live outside of ourselves. We have to give up fighting to hold up the established. Nothing is certain but motion. Our solar system is a type of a healthy social system. In it each one affects, binds, controls, sustains, helps, makes free each other. No star lives for itself alone. Jupiter reaches a helping hand to the earth. The sun sends us its beams day by day. The moon may be dead to itself; it is gloriously alive to us. It has made our lives doubly charming. It has written half our poems. So, in our human fellowship, no one can live to himself alone. Does any one feel himself helpless, let him remember the orb of night.

Only one class of persons is to be deprecated and one tone of speech—the sneering contempt for high aspirations. Notwithstanding the mean and ignoble, the admirable has gained power. The reign of reaction is always brief. The world's great international exhibitions serve as a pacific meeting ground, where humanity may compare notes, not so much to determine what it has done, but what it may do, and will do. This seems to be the inevitable consequence. Already a thousand new ideas are taking occasion of the coming Columbian Exhibition to use it as a fulcrum. Enthusiasm will be the chief characteristic of the fourth centennial of the American continent. Congresses of all sorts mean comparison of merits. Conceits will find a poor welcome. The braggart loses faith in the age as it loses faith in him.

Can we hope for such an evolution as will largely obliterate crime, hate, and poverty? Let us not be children. What we need is to have the fogs dissipated so that we can become upward-lookers and see the hills; we must not be in such haste to finish our work. Let us only have a chance to honestly progress.

HELPFUL HINTS.

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

Modern Theories.

Electicus.—We are not aware that any scientific man of repute believes sound and light to be propagated in the same manner through the respective media. The fact that the earth's atmosphere has a free surface has been recently demonstrated. As for your other suggestions they do not commend themselves to our judgment, but the subjects touched upon are too extensive for *discussion* in our columns just at present. We have so much matter in hand that for the present we must decline the MS. with thanks.

Microscopical Work.

R. J. Williams.—Wollaston's camera lucida is a quadrilateral glass prism, having angles of 90°, 67½°, 135°, and 67½°. It is a very interesting and useful instrument not only for transferring microscope images to paper, but also for copying landscapes, drawings, and other objects. It would not pay you, however, to attempt to make one of these prisms. You can obtain the complete instrument for about 18s. We recommend you to communicate with Mr. George Airy, of 42, Gray's-inn-road.

Miscellaneou .

T. B. Garrad.—The error made in your name was not due to your handwriting, since, as we are reminded in your latest communication, the name was clearly printed in Roman characters upon your letter paper. The responsibility for the error lies with our printer — a fact of which he has been duly notified. For the rest, no doubt, your reasoning is accurate; but what grounds have we for supposing, or even imagining, that deceased scientists will ever find themselves inhabitants of Mars? Your suggestion for the new title is duly to hand. Thanks for your interesting letter upon that subject.

R. J. Crowley.—Glad to hear that you are meeting with success. The experiment you describe may be important, but we can scarcely accept the explanation you give of the result. You should test it further.

Jno. Williams.—We cannot think of accepting your challenge. The "reward" of £1,000 is doubtless a hoax on the part of someone who has simply invented the American references. Not a cent could be recovered from anybody, upon the strength of such a "startling offer" as is published upon the handbill. Then apart from this, most of our readers have been educated past flat earth hypotheses. And if we devoted to these such an amount of our space as would be needed for the rigid demonstration of the motions and form of the earth, Science Siftings would be considered uninteresting, and its demonstrations redundant. Then our circulation would be converted from an increasing, to a decreasing one. Probably this last consideration has not presented itself to you; but we cannot lose sight of it.

E. Naldrett.—We have carefully followed out the description of your machine, and regret to state that the production of perpetual motion in this way would be contrary to the fundamental principles of mechanics. If you are of an inventive turn of mind, you should devote your time first to the serious study of physical science. And defer the exercise of your inventive ability until later. It is impossible for anyone, in the present day, to make so complex an invention as any new kind of motor without having some acquaintance with, at least, the elementary principles of natural philosophy. When you have mastered these you will appreciate the enormously great improbability that force can be manufactured out of nothing, by any human means. At the same time you will discover more useful fields for the exercise of your ingenuity.

T. H. Morgan (Lago Maggiore).—The information conveyed on your post-card was very interesting, but, unfortunately, it was too late for the last issue, and is now somewhat out of date. Our best thanks for your trouble.

A. Richardson Hewitt.—We are not conversant with every form of electric belt, there are so many varieties, but we unhesitatingly condemn all those that do not pass a current through the body.

Guy H. Dawn.—The change of title is an awkward problem; we only change our name because we believe it is for the better. We shall certainly not alter the style of our contents.

E. S. Aires.—Your first communication must have miscarried; at any rate it never reached us. Permission to view the Greenwich Observatory is sometimes accorded on application by letter to the Astronomer Royal.

E. R. London.—You mentioned three 5 candle-power lamps. See answer published in our issue of 27th ult. Will be glad to hear from you further,

Swansea.—You are mistaken. There is no such thing as a brain or brain substance at the base of the spinal column.

A Reader of "Science Siftings."—(1) We regard it as simply a figure of speech to say that Mars is directly overhead at midnight, and as true in the same sense as that in which it is true that the sun is directly overhead at midday. The fact that neither of these statements is exactly true in England is due to purely local (geographical) causes. And it is not, in our opinion, desirable to encumber with the discussion of these an elementary explanation of the celestial motions. There are plenty of good precedents for our view of the matter. (2) The paragraph should have read, "Mars is, of course, nearest to us when it, the earth, and the sun are in one line *in the order named*." This is no doubt what was intended by our contributor. (3) We did not assert that house flies bite, but that they may be the media of the conveyance of contagion.

Jno. Wm. Franck.—Thanks for your friendly letter. Unfortunately there are too few who are attracted by science as it is usually explained. Science has indeed acquired a notoriety for abstruseness and difficulty that is equally unenviable and unjust. While we regret it, we can scarcely hope to entirely destroy this false impression, so long as certain pedantic technical organs obtain even a limited and occasional hearing for their verbose disquisitions. We prefer, therefore, to take leave of the word "science" on our title page. But we shall continue to purvey knowledge—all the latest developments of natural and mental philosophy – in simple language, that, under whatever name, must be equally acceptable to the lover of truth.

Subscriber.—Thanks for your favourable comments. The existence of such a "central sun" as you refer to is purely hypothetical. It may be that our system (the solar system) which is known to be travelling through space with great velocity, moves in an elliptic orbit of enormous extent, under the control of gravitation with such a body as you refer to. But this is nothing more than an assumption. Astronomers have scarcely considered it seriously even in the light of a working hypothesis. Data are wanting, as yet, for the estimation of its probability or otherwise.

A. Hutchinson.—The terms of membership would, no doubt, be given to you on application to the Secretary of the Chemical Society, Burlington House, Piccadilly, and to the Secretary of the Institute of Chemistry, 9. Adelphi-terrace, Strand, W.C.

S. J. England.—The publishers of Science Siftings will be pleascd to supply you with a reading-case, price 1s. 6d., post free.

A. E. Salt.—The paragraph you refer to related to the diameters, not the relative bulk of the earth, the moon, and Mars. We are obliged to you for pointing out a printer's error. What we wrote was: "Mars is, on the *average*, 48,000,000 miles from the earth when in opposition." The exact figure is 48,600,000 miles (141,500,000 – 92,900,000). When the opposition occurs near the planet's perhelion, this distance is reduced to 35,500,000 miles; near aphelion, it is increased to over 61,000,000. At superior conjunction, the average distance of Mars from the earth is 141,500,000 + 92,900,000, or 234,400,000 miles.

A. Egerton.—A little powdered pepsine may be taken with advantage with those meals containing albuminous matter. We will be glad to hear the results of your experiments. Dr. Herschell's address is 5, West-street, Finsbury-circus, E.C.

T. B. Garrad.—Thanks for your caution. We shall not experiment personally with bitter almonds, either as a preventive of or cure for drunkenness; nor would we recommend our readers to rely on any specific other than the observance of strict moderation in the use of alcoholic liquors. A large dose of bitter almonds is, as you state, poisonous. Five bitter almonds have been known to prove fatal to a child, but the lethal dose for an adult is generally not less than about 80 bitter almonds.

DAYLIGHT! WHAT IS DAYLIGHT?

SCIENCE SIFTINGS PUZZLE.

After the awards offered in the last issue of Science Siftings have been made, these competitions will be discontinued until further notice.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention, Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.*, 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.
"Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C.
Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, SEPTEMBER 17, 1892.

SCIENCE NEWS AND NOTES.

"If every man loved all mankind, each of us would possess the world."—SCHILLER.

Our New Title

will, we trust, be duly announced next week. It will not be "Daylight" although we had contemplated adopting that designation.

The Dark Ages,

with intelligence to the fore, may probably never return—at least, in the universal sense. The progress of civilisation is, however, usually subject to interruptions, alternations of light and darkness, and a period of satisfactory advance is sometimes followed by one of retrogression. How many of these fluctuations may have already occurred must remain unknown, they cannot be counted like the rings of timber in a fallen tree, but that they were numerous may be easily inferred. The wave of barbarism which followed the decline and fall of the Roman Empire was not a unique occurrence, but rather a sample of many similar changes which had taken place in earlier days, and typical, perhaps, of experiences still in course of realisation. The ruined cities of Guatemala, when compared with the degraded state of the present population, bear witness that even America, as well as Europe, has had its alternations of light and darkness.

The Early Civilisations of the World

are still for the most part secrets buried in the womb of time. Man's persistency promises, however, many revelations in the near future. We may, for instance, yet learn much respecting early American civilisation, for it has recently been found that the Spaniards brought home with them some Maga books, which may yet be compelled to give up their secrets, and more of them may possibly be found where the first lot came from. The present age is undeniably one of progress throughout the greater part of the world, although in some communities there may be a tendency to retrogression. In China, for instance, the most favourable view that can be taken is that civilisation is stagnating. Neither do the Russians seem to be making any advance, and they must, comparatively at least, be losing ground. There is no visible symptom of advancement among the Turks. But even these three nationalities will, by imperceptible degrees, be carried onward by the force of the example set them by the more progressive peoples by whom they are surrounded. There can be no going backwards in those lands where educational institutions are established—the printing press being recognised as one of them. So far, at least, there has been no manifestation of any tendency in the world, as a whole, to any relapse since the invention of printing. The use to which it is put must ever be onward and upward, and we may confidently hope that our successors will never know anything about dark ages, except as a tradition.

The Ancient Cave Dwellers of Central Asia

have left many speaking records on the face of Nature. Among the most singular of these is a discovery by a party of Russian explorers which is being made the subject of further investigation. In Turkestan on the right bank of the Amou Diara, in a chain of rocky hills near the Bokharan town of Karki, are a number of large caves, which, upon examination were found to lead to an underground city, built apparently long before the Christian era. According to the effigies, inscriptions, and designs upon the gold and silver money unearthed from among the ruins, the existence of the town dates back to some two centuries before the birth of Christ. The edifices contain all kinds of domestic utensils, pots, urns, vases, and so forth. The high degree of civilisation attained by the inhabitants of the city is shown by the fact that they built in several stories, by the symmetry of the strects and squares, and by the beauty of the baked clay and metal utensils, and of the ornaments and coins which have been found. It is supposed that long centuries ago this city so carefully concealed in the bowels of the earth, provided an entire population with a refuge from the incursions of nomadic savages and robbers. Here is a relic of a past civilisation which appears in many respects to be comparable to the most advanced of to-day.

Anthropology is the Science of Man,

and the applications of this science are of value in every department of life, and plead loudly for its increased study. In government and law, in education and religion, men have been hitherto dealt with according to traditional beliefs or *a priori* theories of what they may or ought to be. When we learn through scientific research what they really are, we shall then, and then only, have a solid foundation on which to build the social, ethical, and political structures of the future. It is the appreciation of this which has given the extraordinary impetus to the study of sociology—a branch of anthropology—within the last decade. Anthropology alone furnishes the key and clue to history. This also is meeting recognition. No longer are the best histories mainly chronicles of kings and wars, but records of the development and the decline of peoples; and what constitutes "a people," and shapes its destiny, is the very business of ethnology to explain. So likewise in hygiene and medicine, in ethics and religion, in language and arts, in painting,

architecture, sculpture, and music, the full import and often unconscious intention of human activity can only be understood, and directed in the most productive channels, by such a careful historical and physical analysis as anthropology aims to present.

The Evolution of the Human Skull

is the subject of some interesting notes by Dr. Topinard, of Paris. In tracing the transformation of the animal into the human skull, he demonstrates that this change is brought about by the gradual development of the brain, and the resulting mechanical pressure on the hard parts adjacent. The pressure exerted by the enlarging hemispheres on the occipital bone is in a direction backwards and downwards, so that what is its superior surface in ordinary mammals becomes the posterior in man, and its posterior face the inferior. The occipital foramen (the opening at the back of the head) instead of looking backwards, is in man turned downwards. The increase in size of the anterior lobes of the hemispheres brings about still greater changes in that portion of the cranium. The orbits are pressed from a lateral into a frontal position, the face, instead of being in front and oblique, becomes vertical, and below the frontal lobes; and numerous minor alterations in the anatomy of the parts are necessitated by these changes. It is easy to arrange a perfectly graduated series of skulls illustrating this development from the lowest mammals up to man. Next to him are the monkeys, below these are the lemures, and then follow the inferior mammals. Everywhere the principle of harmonic accommodation of organ to function is strikingly shown. Dr. Topinard's may be considered the most complete demonstration of this evolution on record.

The Poise of the Head

is controlled mainly by the training that the muscles of the neck undergo. The head is the crown piece of the human statue, and is usually in good proportion and capable of proper poise, but a head well set and sustained in due height above the shoulders is a rare sight. A woman of large, full physique will diminish and make herself almost insignificant by a forward stretch and crane of the neck, or a contracted tuck-down between the shoulders, when her whole effort should be to extend and lengthen the support of the head, and to give the full effect of its size. The tall, slender woman, whose head should stand like the bell on the stalk of a lily, gets an idea that she accentuates her height by an upright poise, and is therefore seen with a continued bend of the body and turn of the head to one side, which give her an expression of sympathetic or critical interest, alike with shopkeeper, servant, stranger, and friend. These are small affectations which do no one any harm, but they break the line of contour and beauty, and to the initiated mean lack of culture. The difficulty, in truth, lies oftenest in the weakness of the *point d'appui*—the joint or hinge of support at the back of the neck—and the lack of proper exercise of the muscles of the throat to gain strength and flexibility.

The Uplift of the Chest

has the effect of throwing the head upward, and placing the weight where it belongs—against the joint in the spine. The muscles around and in front are like so many tether cords, loosening or contracting when the breeze of impulse and emotion stirs to movement and change. The slightest deflection from a normal poise, a hold of perfect repose, draws the chin backward and downward, with contraction and rigidity—the usual compressed manner of dignity and self-confidence. Or there is an inclination of the chin upward, which tells of pride and haughtiness, the conventional "airness." A slight stretch, and there is positive scorn and disdain. The backward movement and contraction is found to be usually accompanied by pinioned elbows and clasped hands, and these three habits should be broken up together. Let the first thought for this be relaxation. Realise first the points noted—the hinge at the back, and controlling cords around. Turn the head slowly and gently from side to side as far as it will go without strain. This uses the joint, and develops the stretch of muscle. Next droop the head forward and backward for a few moments. Then the same movement from side to side. Do this with as little will and force as possible, almost as if in a dream. Turn the head gently with a rotary motion, round and round, like a ball held by elastic cords. Do not be afraid, it will not get untwisted or come off. It is marvellous how these simple movements, practised a few minutes at a time during through the day, waken gradually and make pliable the muscles about the throat, and put one in command of the head.

The Physiology of Salads

is a pet theme with M. Henri de Vilmorin, sometime president of the Botanical Society of France. According to this authority, the nutritive value of salads is due to potash-salts, which are usually eliminated from vegetables in the process of cooking; for this reason salad is even more desirable in winter than in summer, being a preventive of rheumatism and biliousness. M. de Vilmorin enumerates the following plants which are used as salads in France:—The leaves of lettuce, corn-salad, common chicory, *barbe de capucin*, curled and Batavian endives; dandelion, green, blanched; and half-blanched; water-cresses; purslane; in small quantities, blanched salsify tops, of a pleasant nutty flavour; Witloef or Brussels chicory, the roots of celeriac or round-rooted celery, rampion and radish, the bulbs of stachys, the stalks of celery, the flowers of nasturtium and yucca, the fruit of capsicum and tomato, and, in the south of France, rocket, picridium, and Spanish onions. Various herbs are added to a French salad to flavour or garnish it, such as chervil, chives, shallot, and borage. In addition, many boiled vegetables are dressed with vinegar and oil. These hygienic hints to housewives, will, we trust, not be thrown away. Many of the vegetables included in M. de Vilmorin's list are of noted medical value.

What Shall we Drink?

is a most prominent question while so much disease is threatening us. Water, as we have frequently said, should never be consumed unless boiled and filtered, and even treated with disinfectants. If a man must drink stimulants, the best thing he can take with his meals is a little claret or light Rhine wine—Burgundy, if it is desired to make blood—and if he wants something a little stronger, Scotch whisky with water is the best thing he can have. The habit of taking a drink early in the morning—a stimulant of that kind commonly called a "pick-me-up"—is one of the worst. The effect of alcohol is to inflame the stomach, and it will do this even when diluted, and will do so a great deal more when taken on an empty stomach early in the morning. The best drink that a man can possibly take is milk after it has been boiled. Milk, though, is hardly a drink. One can live longer on it than on any one thing. Milk is more nearly a perfect food than anything; it contains more elements that go to build up the system than any other article. Early in the morning, the best drink to take is water—

always remembering our cautions. Tea and coffee drunk in moderation will not hurt anybody, although they are both stimulants. We would refer our readers to our comments on the subject of thirst and thirst quenching that appeared in the last issue of SCIENCE SIFTINGS.

Atmospheric Circulation,

that is to say, the permanent winds of the globe, received an interesting exposition from the late Prof. James Thomson, brother of Lord Kelvin. Briefly summarised, this theory teaches that about the equator, owing to heat and rarifaction, a current of air constantly ascends into the higher regions of the atmosphere, and flows away northwards and southwards until it cools sufficiently to sink towards the surface, and form a return current towards the equator. There are, in fact, three great currents, a top main current towards the pole, a bottom subordinate current towards the pole, and a middle current from the pole towards the equator. This middle current is the conjoint return current which, at a certain stage of its journey, becomes the trade wind of the hemisphere it occupies.

The Tenacity of Life Possessed by Snakes

is wonderful. Some men were digging a well close to the Meramec, near St. Louis, U.S.A., when they came on a cavity in the ground which contained a nest of snakes. The weather was bitterly cold, and the snakes were apparently dead. They were all black snakes and harmless, so the men loaded them into the bucket and sent them to the top just for a curiosity. They were thrown out on to the ground and in a little while were frozen as stiff as so many sticks. Their bodies became so brittle with the frost that in handling them several were broken like icicles. One of the men when he went home at night took two or three of the largest along to frighten his wife. He succeeded very well, and, leaving the snakes on the floor in the kitchen before the fire, sat down to eat his supper, forgetting all about them. While the meal was in progress his wife, who had left the room, suddenly gave a terrific scream that made him jump up in a panic and run to see what was the matter. As he opened the kitchen door she fell against him, almost fainting with fright, and too badly scared to tell what ailed her. He soon found out, for on going in to the kitchen the room seemed full of snakes. Warmed by the genial glow of the kitchen fire the frozen snakes had come to life and were coursing round the room with soul-chilling energy. He did not care to tackle the job of killing them there, so he pushed the outer door open and they soon found their way out, and had not gone a hundred yards before they were stiff as ever with the cold. He followed them out and finished them with a pole, but says he will never trust a snake again, no matter how hard frozen.

The Longevity of Birds

remains a debateable question with ornithologists, who for the most part argue that of all animals they have relatively the longest existence. It is established that swans live to be three hundred years old. Knauer, in his *Naturhistoriker*, claims to have seen a large number of falcons a hundred and fifty years of age. Eagles and kites likewise live for a long time. Knauer tells of the death, in 1819, at Berlin, of a sea eagle that had been captured in 1715, that is to say, a hundred and four years previously, and which was then already some years of age. A white-headed kite, taken in Austria in 1706, died in the poultry yard of the palace of Schonbrunn, near Vienna, in 1824, after passing a hundred and eighteen years in captivity. Sea and marsh birds survive several human generations. Ducks and cuckoos are likewise very long-lived. It is claimed that ravens often reach the age of a hundred years. Magpies, which live to a very advanced age at liberty, do not exceed twenty-five years in the confinement of a cage. It is not rare to see domestic cocks of fifteen years, and with care they reach twenty. The limit of the existence of pigeons is ten years; the smallest species live from eight to eighteen years. Nightingales will not endure more than ten years of captivity. Canaries reared in a cage live twelve or fifteen years, but in their native islands they reach an age of several dozens of years. In no department of animal life have we such opportunities of investigation as in the case of birds, and the statistics we give above appear to us unanswerable as regards the argument of the superior longevity of birds.

A Remarkable Invention in Armour,

originating with comparative barbarians, has just come to our ears, and its authenticity is vouched for on good authority. Its publication should lead to the remodelling of many of our modern methods of defence. During a great uprising of the Yaqui Indians, the attacking General was much amused to see the savages use blankets as a shield against his soldiers' bullets. Holding up a blanket at both ends, so that the edge just touched the ground the Indian riflemen marched boldly towards him behind this apparently flimsy protection. The general was soon alarmed, however, to find that his bullets did not stop the strange advance, and the moving fort of blankets soon came so close to him and poured in such a deadly fire that he was fain to fly the field in confusion and great loss. The Yaquis had become acquainted with the simple fact that while a bullet will pass through 20 blankets strained over a frame or laid against a firm surface, it will not penetrate a single one if moistened and hung up so as to swing clear of the ground. The bullets which the General imagined were passing through the Indian blankets and thinning the ranks of the savages, were all falling harmlessly on the woollen bulwarks. English soldiers marching to attack an enemy behind a sodden blanket would indeed be a novel sight.

Writing on Aerial Navigation,

Mr. Thaddeus Hyatt says :—"In your number of Aug. 6, p. 214, occurs a paragraph about bats, which says 'a bat cannot rise from a perfectly level surface . . . if placed on the floor or on flat ground it is absolutely unable to use its wings,' etc. However true the above may be as to some bats (if any such there are), it is not true of all; I caught a bat once while studying the wing movements of flying creatures, and having it securely held by a string fastened to one of its legs, took it out and placed it on the flat ground or grass, and watched it attentively during many experiments. It arose from the ground at a low angle with no perceptible movement of its wings during the first few inches forward, when it flapped them vigorously and went rapidly upward on the incline. I was so struck and puzzled by the creature getting into the air with no wing movement, and seemingly by the power of its mere will, that over and over again I got down on my hands and knees (being near-sighted) so as to get my eyes close to the creature in order to find out the trick; but in vain. It was up and into the air in an instant with no flap of its wings! My present theory as to the initial movement of the bat, is, that as it pressed its hind feet to the ground in the act of rising, its body was projected forward and upward sufficiently to let its wings flap clear of the ground, the two movements being nearly simultaneous."

GLEANINGS OF THE GLOBE.

STEEL needles were first made in England in 1545.

IRON pavements were first made in London in 1817.

THE cotton gin was the work of Eli Whitney, 1793.

ANEMOMETERS were invented by Woflers in 1709.

PITH balls used as electroscopes by Gilbert and many others in 1601.

THE first electric machine, a globe of sulphur, was made by Guericke 1647.

THE electrical properties of amber were discovered by Thales 600 B.C.

SPARKS from amber and other substances were mentioned by Pliny 70 A.D.

IN 1600 Gilbert recorded that other bodies besides amber had electric properties.

THE earth is the greatest distance from the sun on the morning of July 6th.

THERE are 106 boys born to every 100 girls, but more boys die in infancy than girls.

To prevent delicate chintzes and calicoes from fading when washed dissolve a little sugar of lead in a bucket of cold water and soak the dress for two hours. Then wash it.

MR. E. CLARKE, of Forest-hill, writes to say that he has seen and heard rabbits give signals of alarm many hundreds of times, but they never do this with the fore paws—always with the hind legs.

To tighten cane-seat chairs.—Turn up the chair bottom and wash the cane-work thoroughly with soapy water and a soft cloth. Let it dry in the air, and it will be firm as new, provided the cane has not been broken.

AN animal diet, says the *Lancet*, unbalanced by a due proportion of the "kindly fruits of the earth," is distinctly prejudicial to the consumer, particularly to the resident in cities, where opportunities of open-air exercise are few and far between.

MR. JAMES BRYCE, M.P. for North Aberdeen, is one of the few men who have ascended Ararat. He bears out the remarkable statements recently made in our columns by the Rev. John Joseph Nouri. For Mr. Bryce, according to the *Daily News*, also claims to have seen Noah's Ark.

THE Birmingham *Daily Gazette* is now printed, cut, and folded, by the aid of electricity. This is the first daily paper to be so produced, the current being obtained from a central supply station to replace steam power. "Advance" has always been the motto of our enterprising contemporary, and we are not surprised to find it in the van.

JUDGE FURMAN, of Denver (U.S.A.), says that by the use of certain chemicals it is possible to remove the words of a letter and substitute others without detection even under a microscope! Experts in a recent case in Colorado testified to this fact, one of whom actually made the experiment before Judge Furman's very eyes.

HORSESHOES of aluminium have been tried by the Finnish Dragoon Regiment. A number of horses were shod on one fore and one hind foot with aluminium shoes and on the other with ordinary hind shoes. After six month's use the former had worn rather better than the iron shoes, and not one of them had gone in pieces. The horses had all the time been moving on a hard and stony road.

A CURIOSITY in the Botanical Gardens at Washington is a plant afflicted with a genuine consumption of the lungs or leaves. There are three species of this, all of which are being cultivated for this peculiarity; it is the custom of the gardeners to throw away all that seem healthy. The disease first appears as a white spot on a single leaf, which increases and gradually spreads over the entire leaf and then to its neighbours.

THE Victoria combination scale has just been introduced by a company of that name, with offices at 34, Great Queen-street, W.C. It is exceedingly simple in construction, and derives its name from the fact that it can be used as a platform as well as a counter scale. It is easily transportable, weighing only 24 lbs. complete, having no weights, and occupies a remarkably small standing space. Its most important feature is, however, that it weighs with impartial accuracy from ½ oz. up to 245 lbs.

MILK has been found to possess remarkable healing qualities, if applied to wounds in an early stage, and excellent results have been obtained by its use in the dressing of burns. Compresses are soaked in milk and laid on the burn, to be renewed night and morning. An extensive burn has in this way been reduced in three days to one-quarter of its original size. Another burn, which had been treated for eight days with olive oil and oxide of zinc, healed rapidly under a milk dressing.

THE year of greatest growth in boys, says the *British Medical Journal*, is the 17th; in girls, the 14th. While girls reach full height in their 15th year, they acquire full weight at the age of 20. Boys are stronger than girls from birth to the 11th year; then girls become superior physically to the 17th year, when the tables are again turned and remain so. From November to April children grow very little and gain no weight; from April to July they gain in height, but lose in weight, and from July to November they increase greatly in weight, but not in height.

A WORK on chirognomy tells us that there is as much character in the thumbs of people as in their faces. A long first joint of the thumb indicates will power; a long second joint indicates strong logical or reasoning power; a wide, thick thumb indicates strong individuality, while a broad knob at the end of the thumb is a sure indication of obstinacy. The thumb is the characteristic feature of the human hand, a characteristic in which it differs from the hand of the monkey, and of all parts of the hand no one is so strongly individual or telltale as the thumb.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not satisfactorily replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 46.

199.—What is the explanation of the change of seasons?

The cause of the change of seasons is the inclination of the earth's axis to the plane of its orbit round the sun, and depends on the fact that this inclination is practically constant. Mid-spring and mid-autumn, when the days and nights are equal, are called, for this reason, the equinoxes. At either equinox the inclination of the earth's axis lies in a plane very nearly coinciding with the direction of the orbital motion, and at these times a line drawn from the sun to the earth would be very nearly perpendicular to points on the equator. On the other hand, at the mid-summer or mid-winter "solstice" the inclination of the earth's axis lies in the plane passing through the centres of the earth and sun. Since the inclination is constant in direction (see answer to query 110—Ed.) we find that at one solstice, when we have our summer, the north pole is always inclined towards the sun, and the northern hemisphere, having long days and short nights, receives more than the average quantity of solar radiation. Similarly at the other (winter) solstice the southern pole is inclined towards the sun, and our hemisphere experiences more than its share of night. We may conclude that the amount of heat received from the sun is immediately dependent upon the length of the day and upon the greatness of the angle which a line drawn from the sun at midday makes with the earth's surface at the place in question.

200.—Does water, in nature, ever run up hill?

Yes. Water, like every other fluid, obeys the law of gravity in seeking what is called a level—really to shorten the lines joining each particle with every other material particle in the universe in exact proportion to the respective forces of gravitation. The statement, however, that water generally runs down hill, while necessarily true as regards slight surface irregularities on our planet, is only approximate with respect to the centre of figure of the earth. The reason is, of course, that the earth is not truly spherical and that its density is not uniform, but concentrated towards the equator. The fact is that any ocean current running towards the equator runs, with respect to the centre of figure of the earth, uphill. Even rivers may do the same provided that their "fall" with respect to the sea level in corresponding latitudes is not too great. Thus the distance from the centre of the earth to New Orleans is nearly 3 miles longer than that from the centre of the earth to Cass Lake, the most northerly point of the Mississippi river.

201.—Is colour photography possible?

Colour photography is possible to the same extent that it is possible to imitate the tints of Nature in any oil painting or chromolithograph. For methods have been devised by which the photographic effects of the coloured rays of light constituting a photographic image may be differentiated in almost an infinite number of ways. The resulting photographs of special tints and of special shades only may be transferred to lithographic stones, and printed from successively in any order with appropriate coloured inks. The expense of making these diversified photographs of the same object, and of carrying out the successive and exactly superposed printings is, however, considerable. In fact the expense is considered by manufacturers of photolithographs to be prohibitive. No more direct process of colour photography has yet given results of a promising character.

202.—Is it possible to register the pulse beats by mechanical means?

The sphygmograph or sphygmoscope is used for this purpose. It is a combination of levers having at one extremity a point, which traces upon a piece of lampblacked paper, fixed on a revolving cylinder, a wavy line, corresponding in the frequency and extent of its sinuosities with the motions of the pulsating vein. The paper is prepared by holding it for a moment in a smoky flame; and after it has been used the resulting "arteriogram" is fixed by dipping the marked paper in shellac varnish and drying.

203.—What is the cause of an earthquake?

An earthquake is the result of a violent disturbance at some point, described as the "seismic focus," and usually situated at a depth of from 5 to 30 miles below the surface. It has not yet been found possible to determine precisely the nature of this disturbance. It may be due to the collapse of subterranean caverns that have been formed by the solvent power of water; or it may in some cases be due to the sudden evolution of steam. The earthquake shock is essentially a wave, or series of waves, of *sound* travelling through the earth at the average rate of about 1,000 feet per second—rather less than the rate at which sound travels through the air.

204.—Where does the light go to when a candle is blown out?

Light is an etherial vibration. Considering the last pulse of light that is given out before the extinction of the candle, we are led to suppose that it extends itself in every direction with enormous rapidity—that it travels as a continually expanding thin spherical shell of etherial disturbance. Where this wave impinges on a material substance its energy may be for the most part absorbed or converted into heat. Otherwise it may be propagated through infinite space. If it should be discovered that the properties of the ether are in any way modified by extreme heat and cold, there would be ground for assigning a sensible specific heat to the ether, and for supposing that the light radiated into space must be eventually absorbed. Again, since there is probably a large quantity of gaseous matter dispersed through space, this alone will account for a considerable absorption of the radiated light. (See also an article on "Creation and Chaos," in our issue of March 12th, and a paragraph in "Gleanings," in our issue of Aug. 6th., last.—Ed.)

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

211.—What is daylight?

212.—What is the poisonous firedamp met with in coal mines?

213.—What is the principle on which lithographic printing is based?

214.—What is the origin of the beautiful designs seen in snowflakes under the microscope ?

215.—What is the most successful or promising method of aerial navigation ?

216.—What is the distinction between pebble and glass spectacles ?

SCIENCE AND ART.

It appears to be a natural law that the scientific and artistic habits of mind rarely or never exist in the same individual. One is analytical, the other synthetical, and the instances are few where persons have been distinguished both in scientific and artistic or literary fields. Even Darwin admitted that, as he pursued his biological studies, he lost his interest in music, which in his earlier years was a source of great enjoyment to him.

To this incompatibility of temperaments may be due the curious and often ludicrous mistakes made by artists in depicting landscapes, or writers in describing scenes from Nature. The remarkable sea picture by Turner, in which anchors and chains are seen floating in the water, cannot be explained in this way, but is rather an exhibition of "crankiness" and affectation, pure and simple. Less palpable errors, however, are by no means uncommon. The moon is perhaps one of the most misrepresented objects in Nature. The crescent moon is so much more beautiful than the fully illuminated disc, that it is used by preference, even where its appearance would be in defiance of all astronomical laws. We often see a picture of a landscape or marine view at midnight with the crescent moon riding high in the sky, when, in fact, the crescent moon is never seen far away from the sun, and always sets shortly after, or rises shortly before, the greater luminary. In a popular romance published a few years ago, a beautifully worded description of a twilight scene was spoiled by the introduction of the crescent moon rising in the east just as the sun disappeared behind the western hills. Only when at the full can the moon rise at sunset. A leading daily paper recently explained the occurrence of a very high spring tide, by the somewhat startling statement that it was due to "the simultaneous rising of the full moon and the tide at midnight."

We may also mention that the discs of the sun and moon are always represented many times larger than an actual measurement would show them to be ; but this is not a serious error, as a picture is intended to represent things as seen by the eye, and the apparent size of the sun and moon is greatly increased by an optical illusion.

The rainbow is another favourite subject with artists which is too often handled with little regard to optical laws. It must necessarily always be directly opposite the sun, and consequently one cannot look at the sun and the rainbow at the same time. But it is almost invariably the case that both sun and rainbow appear in close proximity in the picture ; and although in order to form a perfect arch across the sky, the sun must be near the horizon, yet it often happens that we see a picture of a beautiful semicircular bow in a picture which is intended to represent the scene at noon or an hour or two later.

A practical suggestion in this connection would be that artists avail themselves of the assistance of the camera in making their preliminary sketches. The photograph shows things exactly as they are, and is free from the slightest suspicion of "idealism." While an ideal representation is often very desirable and beautiful, it is much better for the artist to have a basis of actual fact to begin with, and from this he can alter his lines to suit his own taste without the danger of committing errors like those described above.

A curious error on a physiological subject occurs in Shakespeare's *Othello*. After Othello has suffocated Desdemona in a fit of jealous rage, she speaks and explains matters satisfactorily to her impulsive husband, and afterward dies "regretted by all who knew her." But if Desdemona was able to speak, she must have been able to breathe, and Othello's attempt at asphyxiation must have been unsuccessful. There was not the slightest excuse for dying under such circumstances, and Shakespeare should either have caused Othello to accomplish his murderous purpose by some other method, or have allowed Desdemona to have been completely suffocated at once, and left the explanation of affairs to some of the survivors. Shakespeare is rarely at fault in such matters, and doubtless availed himself of the knowledge of his son-in-law, Dr. Hall, who was quite a distinguished physician in his time.

A NOVEL WAY TO BOIL WATER.

It sometimes happens that one is in need of a little boiling water at a time when there is neither a fire at hand, nor the proper utensil to heat it in. This frequently happens to the man living in a boarding house, when he wishes to shave late at night. It was probably an individual just so situated who first hit upon this rather ingenious way of getting himself out of a difficulty, that has no doubt perplexed many of us. When the writer saw it done it was on a wager, and the operator said he had won many bets by it, as the thing seemed impossible until it was demonstrated.

The person in question first took a sheet of ordinary foolscap writing paper. This he folded up just as a child does when it makes a paper boat. Care was taken with the ends, and they were made waterproof by being folded over several times. The boat was then filled with cold water, and held over the flame of a gas jet. Instead of setting the paper on fire in an instant, as one would naturally suppose, the gas began to boil the water, and in a few minutes it was bubbling in the paper boat. After the boiling water was poured out, the portion of the paper that had been in the gas was found to be smoked black, but when this was rubbed off, as could easily be done, the paper was just as perfect as it was before the test had been made. Besides being a matter of convenience in case of emergency, this simple experiment can be employed profitably for the purpose of amusing young people.

AN ECCENTRIC CAT.

A CURIOUS story is told of a "right-handed" cat. The individual who is responsible for these facts tells us that "he sometimes laps milk like other cats, and sometimes sits close up to the pan and dips his paw in the milk and carrying it to his mouth, licks the drop of milk off. Noticing that he always used his right paw, I tried to get him to use the left one, first by setting the pan of milk on his left side, and afterward by dipping his left foot in the milk, so as to get him started in the use of the left. He would shake the milk off his left paw and go on eating with the right one, and we have never, by any expedient, been able to get him to eat with the left paw."

HARNESS INTERVIEWED.

By G. W. de Tunzlemann, B.Sc., M.I.E.E.,
Principal of Penywern House Military & Engineering College.

Towards the end of last year (1891) one of Harness's belts was submitted to me for an opinion upon its value as an electrical appliance. The belt had been obtained by the purchaser from Mr. Harness's establishment in Oxford-street, and the name "C. B. Harness" was stamped upon each one of the metal discs attached to it.

Before making my report, I wished to see Mr. Harness's establishment, in order to ascertain for myself whether the various belts advertised and sold by Mr. Harness were of a type similar to the one submitted to me. I accordingly paid a visit to Mr. Harness's shop, in Oxford-street, accompanied by a scientific friend. On arrival, I requested that some belts should be shown to us, and explained and tested for our information, as Mr. Harness in his advertisements offered to do.

An assistant thereupon showed us over some very well-furnished waiting rooms, and some smaller rooms, which he described as consulting rooms, one of which contained a large Wimshurst Influence Machine, to which was attached an enormous label, bearing the name "C. B. Harness." The assistant also produced some belts, all consisting of a number of discs, apparently of tinned copper and zinc respectively, grouped together in various ways upon ordinary webbing, and connected by means of cords composed of string and wire twisted together, as in the specimen submitted to me. The assistant informed us that these different patterns of belt were devised for the cure of various classes of disease, but the only information we could extract from him, in the way of explanation, was that they contained positive and negative poles, which acted on the MOTOR CENTRES !!!

I then asked him whether the current passed merely over the surface of the skin, or right through the body, and he replied that it passed through the body, and not merely along the surface.

I then asked him to have a belt tested for me, but he excused himself on the ground of the time it would take, offering, however, if I would purchase a belt, to have it tested for me. In reply to this, my friend remarked that their system then was to require their belts to be purchased first and tested afterwards. Mr. Harness, who was standing near, disclaimed this, and offered to test a belt in our presence. He then produced a belt with four groups, of six discs in each group, all the discs in a group being of the same metal, and connected together, and with no connection between the groups. He then dipped a piece of flannel into a liquid, which he said was sea water, placed it between two groups, consisting of different metals, connected each of the groups, by means of a terminal in connection with it, and projecting through the material of the belt, to the terminals of a d'Arsonval galvanometer, and pressed the discs tightly against the wet flannel. Of course, a considerable deflection was produced, as any tyro in electricity could have predicted. Mr. Harness informed us that the flannel was supposed to represent the human body, the sea water taking the place of the moisture of the latter, and that when the body was used a much larger deflection was obtained.

I have no means of knowing whether this statement was due to utter ignorance and incompetence on the part of the self-styled "Eminent Consulting Medical Electrician," or to his belief in our unlimited ignorance and gullibility. Mr. Harness, moreover, omitted to point out to us that when the belt was worn in the ordinary way, the external connecting wire would be absent, and, therefore, the circuit would be incomplete, making a somewhat important distinction between the actual case and the case to which the test was applied. This would be evident to anyone with the most rudimentary knowledge of electricity, but we must in charity assume that Mr. Harness's omission was due to his ignorance in this case also.

I then asked Mr. Harness to explain the action of the belt of the type which had been submitted to me, in which the elements instead of being an open circuit were short-circuited, though I did not put my question in these terms, as I did not suppose that Mr. Harness would know what I meant. The only answer he would give, though my question was couched in the simplest language, was that it would take all the afternoon to go into a scientific explanation of it, and that he had patients waiting for him. I attributed his reticence on the matter to the fact that before beginning his so-called "test," he had asked me if I knew anything of electricity, to which I was, of course, obliged to reply that I did know something about it.

After my visit, I had no further hesitation in advising my client that the belt submitted to me was totally incapable of maintaining continuous electric currents through the body, as asserted in the advertisements, and that, as arranged, the belt could not even claim to be considered an electrical appliance at all. I therefore advised him to sue for the return of the money paid for it, as having been obtained under false pretences.

The following is a specimen of Mr. Harness's bombastic way of treating the criticism to which he has been subjected. The letter is addressed to a contemporary:—

The Zander Institute.

Sir,—I have continually drawn public attention to the value of the electropathic treatment of disease introduced into England and perfected by me after many years of study and labour, and also to this Institute established under my direction, where the practical application and working of the system is day by day freely demonstrated and explained to all who care to interest themselves in the matter.

You can readily understand and appreciate the difficulties which have had to be surmounted in combating popular prejudice, born of a profound ignorance concerning everything appertaining to electricity as a therapeutical agent, and fostered by that conservative instinct so inherent in our countrymen.

This has been, however, to a very great extent overcome, and I have now the satisfaction of knowing that the majority believe in me and my system. It could hardly be otherwise, for I have done admittedly good work and have stood in the full blaze of publicity for a number of years.

But there still remain many sceptics, and in their interest, as well as my own, I feel that the time has arrived for an effort upon my part to convince them.

Therefore, Sir, I invoke the powerful aid of your journal, which has ever been in the van of culture and progress. I have had an experimental and testing room especially fitted up for the reception of visitors, with the object of challenging in an open and friendly spirit the fullest and freest investigation and skilled criticism.

May I, in the interests of science and the public health, ask you to send an accredited representative to me at any convenient time, to whom I shall be delighted to offer every facility for inspection and independent judgment? I desire unbiassed and exhaustive criticism even if it be adverse, of which I am not in the least apprehensive.

Apologising for the length of the letter and thanking you in anticipation of your courtesy in complying with my request,

I am, Sir, yours faithfully,

C. B. Harness.

(*More of this next week. We commenced the Subject in No. 42.*—Ed.)

MORE ABOUT MARS' SATELLITES.

The satellites of Mars are peculiar as being the smallest heavenly bodies whose orbits and sizes have been even approximately determined.

Phobos, the inner moon, having a diameter of about eight miles, is of a size easily comparable with the earth and objects upon the earth's surface, its diameter and circumference being respectively almost exactly $\frac{1}{1000}$th of the earth's diameter and circumference.

Let us suppose everything on the surface of the earth to be reproduced on the surface of Phobos, as men, trees, ships, mountains, rivers, etc., all reduced in size proportionately. It would be only necessary to divide by one thousand the dimensions of any earthly object to ascertain its dimensions as modelled on a Phobian scale.

A man six feet high would, on this scale, stand 0·072 inch of our measure on Phobos, and looking down with our human eyes to find him, we should have to look for an oval object about 0·022 inch diameter in its longest dimension, as we should see only the head and shoulders. A good magnifying glass would be needed to determine the real character of the mere speck that would be visible to an unaided human eye at a distance of two or three feet from the surface, on which it would be seen to crawl with a painfully slow motion.

A few species of our larger birds could be seen in flight without a magnifying glass; only a few, the ostrich, the condor, the swan, could thus be discerned when their wings were not extended.

The altitude of the highest mountains would not exceed thirty, and the profoundest depths of earthly seas yet sounded would be represented by twenty-six of our feet.

A ship of the size of the "Great Eastern" sailing on a Phobian ocean would be less than $7\frac{1}{2}$ inches long. A right whale of average size reduced to our Phobian scale would be less than five-eighths of an inch long.

A railway train of ten Pulman carriages with locomotive and tender would have a length of less than six of our inches and its breadth would be represented by a line less than 0·02 of an inch in thickness.

An earthly river, two miles in breadth and one hundred feet deep, would be represented on Phobos by a stream a little more than $10\frac{1}{2}$ of our feet in breadth, and $1\frac{1}{5}$ inches in depth. Let this river be frozen over with a sheet of ice four Phobian feet thick, and the ice would be only as thick as a sheet of drawing paper.

A square $2\frac{1}{2}$ of our inches on each side would represent a Phobian acre of land. A city like London built to the Phobian scale would have streets ranging from four-tenths to one and two-tenth inches wide, and these would pass between buildings ranging from six-tenths of an inch to two and four-tenths inches in height.

Having thus constructed an earth to the scale of Phobos, in which, to unaided human eyes, only the largest quadrupeds and fishes would be visible, wherein we should have to look for all but the largest birds with microscopes, and in which all insect life would be undiscernible by any means at present known to us, let us suppose an ordinary sized man transferred to its surface.

If a good pedestrian, he could walk over the Phobian equator, circumnavigating the globe, in six of our hours, making strides of three thousand Phobian feet. The soles of his walking boots would be thirty Phobian feet thick. Each hair of his head would be ten Phobian inches in diameter. His feet would be over nine hundred Phobian feet long and about three hundred feet in breadth. In walking he would raise the toes of his feet above the heads of the Phobians to a height of five hundred feet. If his stature in earthly measurement be taken as five feet ten inches, he would tower into the Phobian sky to a height over one and one-tenth miles.

Enormous giant as such a man would be to our imaginary Phobian, he is, as compared with our globe, no larger than such an inhabitant of that satellite would be as compared with his little world. The truth is, there is no absolute standard of large or small. Size is strictly relative, and the physical man, considered in relation to the universe, is nothing but a material point—a centre of vital mental and moral forces, whose effects reach as far beyond the limit of his ken as the universe extends beyond the power of his vision. The life of man is a brief and narrow strip of imperfect light, bordered on either side by impenctrable mystery.

THE SUEZ CANAL.

The Suez Canal is about eighty-eight miles long; of this sixty-six miles are actual canal, formed by cuttings; fourteen miles are made by dredging through Lake Mensaleh, Lake Timsan, and the Bitter Lakes; and eight miles required no work. The canal has a width at the bottom of 72 feet; until 1883 it was 26 feet deep; at the surface its width varies.

At El Guisa, where the canal passes through hills from 30 to 85 feet high, the width is 197 feet; through Lake Mensaleh the width of the channel is 250 feet at the surface, but the water extends some distance on either side of the buoys which mark the navigable canal. In 1883 the operation of deepening it was begun, lasting until the end of 1888, when the canal had a depth of about 33 feet; vessels drawing 25 feet 7 inches have been allowed to pass through it since April 15, 1890; before that time only those drawing less than 24 feet 7 inches were allowed.

On March 1, 1887, the electric light was introduced along the canal, and vessels paying extra tolls were allowed to pass through by night. Steamers travelling by day only take a few minutes over twenty-nine hours, while those using the electric light get through in twenty-two hours. The fastest passage was made in 1891, and took fourteen hours and fifteen minutes. Of course steamers cannot pass while both are in motion; so turn-outs are provided every five or six miles; it is the time spent in waiting in these turn-outs for other vessels to pass that makes the passage take so long. In 1890, 3,389 vessels passed through the canal.

Artificial incubation is by no means so new a thing as the men who build patent incubators would have us believe. In "Sir John Mandeville's Travels," a book written about 1356, he tells of a nation that hatch the eggs of hens and geese by means of little furnaces that were kept at an even heat. In More's "Utopia," about 1516, the idea is repeated, the author asserting that in Utopia eggs were hatched by placing them under cover, in a contrivance that preserved an uniform heat until the incubation was complete. It is somewhat singular, to say the least of it, to find what has been believed to be a peculiarly modern contrivance pointed out by two authors so distant in time from each other and from us.

SIFTINGS ABOUT STORMS.

The terrible storms variously called West India hurricanes, Bengal cyclones, and typhoons of the Indian Ocean and the China Sea, belong to a class of weather disturbances more destructive than any other, and quite apart in several other respects from all others. "Hurricane" is a term derived from the Spanish, and used mainly in the West Indies ever since those islands were first visited by the subjects of Ferdinand and Isabella. "Typhoon" is also local in use, peculiar to the Orient. "Cyclone," however, is of more general application, having been coined by Piddington, an investigator of the last century, out of the Greek "Kuklos" (a circle), because of the supposed movement of the winds around a common centre, and the approximated circular shape of the storm. Piddington, however, was mistaken slightly, for the winds really blow inward, spirally, and not in an exact circle.

The true cyclone, it should be noted, is a very different thing from the tornado, to which its name is often misapplied, The cyclone is not only born at sea, but its life is mostly or entirely spent there; the tornado's birth and career are limited to the land. The cyclone is from 150 to 500 miles in diameter; the tornado is seldom over 1,000 feet through, generally much less. The cyclone lasts for days, or even weeks, and, owing to its immense size and slow progress, it may afflict any one spot, islet or coast town, or a ship at sea, more than twenty-four hours; the tornado rarely endures over an hour, or travels more than twenty or thirty miles, and its passage over any given farm or city is effected in a minute or two. Its overhanging funnel shaped cloud and dull roar may herald its approach by at least five minutes, possibly, but not telegraphic, barometric, or other notice can be given of its existence and probable course.

The barometer, cirrus cloud movements and other indications may foretell the coming of a cyclone, ten or fifteen, or even twenty-four hours beforehand, and the telegraph in some instances will report its existence, if not its probable track, two or three days in advance. The wind velocities of the two types of storms, moreover, are dissimilar. The tropical cyclone, when well developed, is attended by winds blowing 100 or 125 miles an hour. At Cape Lookout, on the North Carolina coast, on August 18th, 1879, a storm that had originated near the Windward Isles a week before registered a velocity of 138 miles an hour, before the registering apparatus broke; and the Signal Service observer there estimated that the rate increased to 165! These figures, like the velocities of 180 and 200 miles reported in rare instances will stand a little discount.

Some of the most destructive cyclones have well attested velocities of between sixty and eighty miles only. In the tornado, however, the air probably whirls ten times as fast as this. Indeed, it has been asserted by some authorities that the effects produced by certain tornadoes required a velocity of over 1,000 miles an hour—something almost inconceivable in terrestrial phenomena. It is the enormous size and long endurance of the real cyclone, a far worse marine monster than any which ancient or modern mythology ever created, that makes it so destructive. Mr. Scott, in his "Elementary Meteorology," mentions one cyclone which raised the level of the sea at the mouth of the Hooghly estuary 16½ feet above the highest known tide-level, and another which covered the land of the Ganges delta from 10 to 45 feet, as measured by marks on trees, and drowned 100,000 people!

Stories are told, though, of the famous hurricane of Barbadoes, one of the Windward Isles, in 1870, to the effect that the bark was blown off from the trees, and cannon were tossed about in the air like chaff. But these gales evidently were of exceptionable fury. Finally the cyclone and tornado differ in this respect. Of the latter there are hundreds reported every season; of the former, in the West Indies and other parts of the globe thus affected, perhaps not more than a score or two, and less than half of them are historic in their havoc, although the mischief wrought by these storms depends largely upon the course they take, and not alone upon their violence.

The special localities in which true hurricanes are born and the times at which they are generated indicate two of the more important causes of their development. Heat which makes the air rise in eddies, and vapour which, being carried up with that air, becomes chilled, turns into rain, and then gives out latent heat that strengthens the upward and inward draft of the system are regarded by some meteorologists as the initial causes of great storms, especially in the tropics, although it is possible that other more obscure forces are also at work. Every one knows that the hottest weather comes in the summer, and is to be found near the equator, and the most vapour is over the steaming ocean. The middle of summer on land is in July in our hemisphere; but the highest ocean temperatures come late in August, especially in low latitudes. But the sun being north of the equator, that line does not mark the region of greatest heat.

The "thermal equator," which shifts up and down on the globe with the changing seasons, is in August several degrees north of the geographical equator. Then, owing to the combined influence of north-easterly and south-easterly trade winds, the surface layers of all oceans have a westerly drift, so that at the time which might be called "marine midsummer," the hottest water is massed in that portion of the Atlantic just north of South America—the Caribbean Sea, the Gulf of Mexico, and around the Bahamas, the Antilles, and the Windward Isles, in those two great divisions of the North Indian Ocean, the Arabian Sea and Bengal Bay; and in the West Pacific, around the Phillippine Island and Japan, and in the China Sea. There, day after day through August, a temperature of from 85 deg. to 95 deg. Fahrenheit almost constantly prevails, and the air is filled with invisible but potent vapours.

During the corresponding season of the Southern Hemisphere in February, the thermal equator is south of the great girdle of the earth's waist; the two trade-wind systems have moved down, too, and the hottest water is then in the region near the Samoan and Fiji Islands, and in the western part of the South Indian Ocean. It is here, therefore, that the hurricanes of that time of year occur. But the causes which produce these storms may operate weeks before and weeks after the culmination of the summer, so that the period within which cyclones may be expected in the Northern Hemisphere ranges from July to October, though the majority of them occur in August and September. An imperfectly developed specimen in 1889 came up out of the tropics as early as May 21. And another storm of this class visited Colon, on the Isthmus of Darien, on December 2, 1885. But these are exceptional cases. Speaking of the recent Mauritius hurricane, which nearly destroyed the town of Port Louis and took thousands of lives, Dr. Meldrum said that similar visitations usually came between December 1 and April 1 (late summer and early autumn in that hemisphere); and this one (April 29th) was

unprecedently late. So in the South of the Pacific. The historic Samoan cyclone of March 14—16, 1889, which wrecked several men-of-war in the harbour of Apia, was in the height of the season for that part of the globe.

The natural effect of gales at sea is exceedingly rough water. But apart from the very high waves which vessels encounter in and near these hurricanes there is occasionally a solitary billow of exceptional height that overtops all others, and overwhelms all but the staunchest and best managed vessels. Late in July, 1887, while less than half way from Queenstown to New York, the steamship "Umbria" ran into one of these waves, and in an instant her upper works were torn almost to pieces. Almost the whole ship was under water at one time when the rolling mountains struck her. The great mass was discovered by the watch, and the vessel's prow put straight into the wave, the engines being stopped for the moment. The "Gallia," two or three years later, had a similar experience, the crest of the billow reaching nearly to her masthead.

This phenomenon seemed to differ from the abnormal rise of sea level from long-continued winds, to which reference has been made. And it is difficult, now and then, to say whether certain effects reported after a storm are due to the one cause or the other. Both are called "tidal waves" rather indiscriminately. Thus, in the West India hurricane of 1780, which blew the bark from trees on Barbadoes, it is said, the ship "Ladbury Snow" was left high and dry on Elliot's Key and her anchor was found in a tree top. Twenty thousand persons were drowned by the flood. This may have been the result of a single, momentary wave; although the additional statement, to which Maury, in his "Geography of the Sea," gives credence, that the Gulf Stream was forced back to its source and the Gulf of Mexico raised 30 feet above its ordinary level, renders it probable that a heaping up of the waters occurred which lasted several hours, if not a day or two.

Although the gales in a genuine typhoon are so terrible that even the stoutest ships rarely survive them, there is a spot at the very centre of the storm where almost a dead calm prevails. From the outer edge of the system, perhaps 300 miles across—the diameter slowly increases after the storm has got out of the tropics—the wind velocity increases as one goes inward until within a few miles of the centre. Then suddenly there comes a lull. The rain ceases and the sky often clears. But in a few minutes—perhaps not for an hour—the progress of the ship, or of the storm itself, brings the mariner into the other half of the cyclone. Suddenly the wind springs up with awful force from another quarter, the skies cloud, and torrents of rain begin to fall. This little calm area is called by sailors "the eye of the storm." Not infrequently a group of butterflies are imprisoned in this aerial cage, as blithe as if hovering over flowers on *terra firma*, but as helpless as if in a collector's bottle. Birds, too, become entangled in this way and are borne hundreds if not thousands of miles from home. The skilful navigator, who has studied the subject, aims to keep his vessel away from the centre of a storm. From the direction and increasing force of the wind, from his position in reference to the tropics, and from his recollection of the latitude in which a hurricane track should recurve, he can usually steer towards a safe quarter and escape the worst of it.

The barometer on sea and land, is probably the most important guide, when a cyclone is approaching, although the conduct and form of clouds as well as the behavior of the wind, also deserve study. From the outer edge to the centre of a hurricane the mercury in a barometer will often fall an inch or more in a day. So narrow and severe was the Mauritius storm of April 29 that between 6 a.m. and 2 p.m. on that day the readings fell from 29·66 inches to 27·99, or an inch and two-thirds in eight hours. By 9 p.m. the barometer registered 29·72, a rise in seven hours to a higher point than at 6 a.m. At Martinique, August 18, 1891, the barometer kept nearly steady until 2 p.m., when it read 30·04 inches, and was slowly falling. Before 8 p.m. it registered only 2·898, a fall of over an inch, most of which occurred in the last two hours. After a few minutes' pause the mercury started upward, and at midnight it was virtually back where it was early in the afternoon, recovering its ordinary level in half the time it spent in going down.

In the storms of the temperate zone a barometric change of an inch is infrequent except in winter, and even then it occurs much more gradually. To the sailor, therefore, the barometer is almost as necessary as a compass. The only effect of a tornado on a barometer is about the same as that of a thunder storm. A gradual and very slight fall for an hour or two previous, about ·05 or ·08 of an inch in all—not enough to be significant—and then, a moment before the onset, a rather sharp rise to the same extent. A slight and gentle decline thereafter completes a saw-tooth-like irregularity in the trace of a self-recording barometer.

AN ANCIENT JAPANESE BURIAL COSTUME.

Prof. Hitchcock, of the Smithsonian Institution, calling attention, in a paper on Ancient Tombs and Burial Mounds of Japan, to some small clay figures representing human beings, said it was an ancient custom in Japan to bury the retainers of a prince standing upright around his grave. The compassion of the Emperor Suisina (97-30 B.C.) was aroused by the sufferings of the persons who were thus treated when his younger brother died, and he desired to change the custom. When the empress died, the plan was proposed of substituting clay figures of men and horses for the living victims.

From the publication of an edict in the year 646, forbidding the burial of living persons, and also the burial of gold, silver brocade, diaper, or any kind of variegated thing, it is inferred that the custom of living burial was kept up to some extent till the seventh century. Specimens of the figures, called *tsuchi ningio*, introduced to take the places of the living sacrifices, are now very rare, and this fact leads to the supposition that the figures were not buried, but were left exposed on the surface of the ground.

THE FIRST MATCH.

The first phosphorus match was made in the penitentiary at Hohenasberg, Germany. The inventor was John Frederick Komerer, a political prisoner. Komerer was a chemist by profession and was permitted to make scientific experiments by his unusually humane jailer. A year after he struck his first lucifer match, Komerer was set free, only to find that he, a penniless man, had to fight capitalists who were interested in his discovery, on which no patent was then obtainable. The German government thought matches dangerous and injured the inventor still further by prohibiting their use. This ruined Komerer, who died in extreme poverty.

THE RISE FROM BRUTE TO MAN.

As might be supposed, the spinal column exhibits the signs of remarkable modifications adapting it to the erect position. Prior to the fifth uterine month the spine of the fœtus is found to be in a wide dorsal curve suited for the accommodation of the viscera, as is the case in the quadrupeds. Naturally such a curve would make the weight supporting incident to the erect position quite impossible; therefore this main curve is counteracted by two that are so placed as to regain the erect equipoise. One of these is in the neck, so placed as to facilitate the balancing of the head; the other is in the region of the loins and aids in the maintenance of the centre of gravity in the proper position. This transformation has been a gradual one; some of the lower races of men have the spine approximating that of the gorilla and ourang, no abrupt line of demarkation existing between them; and in some the backbone is much better fitted for running through tropical jungle and hammock land than for walking perfectly erect in the open.

The theory, now generally accepted by anatomists, that vertebrate animals are compound organisms, "formed by the union of a series of disc-like segments arranged on a longitudinal axis," indicates their ascent from some form closely allied to the annelid worms, in which a single segment produces by continued budding, or self reproduction, a complex body. This theory is fully warranted by a careful study of the human embryo, the uterine life of which exhibits a series of just such transformations as such ascent would call for. Without taking the skull into consideration there are in the human adult thirty-three or thirty-four vertebræ that are the representatives of this segmentation; while such segmentation was doubtless originally uniform in character, continued change in duties to be performed, and in the environing muscular and vascular systems, working both directly and through a long line of inheritance, has resulted in a marvellous system of modifications from which are derived such widely differentiated segments as those of the neck and those of the thorax, with their attached processes, the ribs. In the adult thirty-three post-caput vertebræ are the rule, while at one period in the life of the fœtus thirty-eight may be counted.

The extra segments are not always wanting in the adult, however; but when present they are always to be found in the caudal series, where they form the continuation of the bony structure of the rudimentary tail which is yet present in all skeletons. Lissner has given a careful description of a girl of twelve in whom this surplus segmentation, being covered with flesh, formed a well defined tail 12·5 centimetres (nearly five inches) long. Dr. Max Bartels, of Vienna, has collected from the widely diffused medical and scientific literature reports of 116 actually observed cases of tailed men. Some of these refer to whole tribes; they are from all parts of the globe and cover the period of the last one thousand years. Some of these record instances where these appendages were of much greater length than that described by Lissner. It is quite plain that the erect position, causing a constant rubbing of the basal vertebræ of this appendage between the *glutei*, and the consequent increase in the use of the sitting posture likely to be a result of upright walking, would in time account for the disappearance of the tail in man, though its now rudimentary root and its occasional reappearance in a somewhat atrophied state seem to be sufficient to rob us of any lordly feelings that we may be inclined to indulge in when viewing our distant relatives the tailed monkeys. Nor are these all that we can find in this region that are calculated to humble us in this way. The *ischio-coccygeus* and the *sacro-coccygei*, muscles for flexing, extending, and laterally moving the tail, still are to be found in a vestigial state. So, too, we may discover in ourselves, at that point where, if present, the tail would appear, a dimple often surrounded by a faint whorl of hairs, both of which are indicative of the regressive growth that has taken place.

In the thoracic and visceral regions much is to be found that is indicative of this upward struggle; here it is that we find the least perfect adaptation to the present posture. Nature still clinging to structural forms that, while well adapted to quadrupedal locomotion, are a positive menace to the upright animal. Among these the most prominent is that of the *cæcum*, with its *appendicula vermiformis*, well termed a "death trap." This has long ceased to be of functional value to man; far down the line of his vertebrate ancestors must we look to find it in a state of useful activity. Yet in the four-foot higher animals it is so positioned that gravity frees it from fæcal accumulations which in man, on account of his erect position, find a lodgment therein, causing inflammation. So serious is this, that cases where a grape seed or like object has found this trap a good lodging place, and death has been the consequence, are by no means rare.

The position of the urinary bladder is another almost equally naked illustration of the disadvantage under which man still labours in the erect position. In the lower mammals the urethra is so situated, by virtue of their horizontal position, that it perfectly drains the bladder, while in man, as pointed out by Dr. Erasmus Darwin so long ago as 1805, "the fundus of the bladder in an erect posture is not exactly over the insertion of the urethra; whence it is seldom completely evacuated, and thus renders mankind more subject to the stone than if he had preserved his horizontality." So, too, is it with the positions of the great venous trunks and some of their valves. The horizontal position is favourable to the regular and safe flow of the blood. Some of the valves are so placed while man is erect that they are entirely useless; but let him assume the horizontal position, and it will be observed that they and the entire system to which they belong are so placed as to be operated by the action of gravity. Clevenger has demonstrated that to these valvular inequalities in the biped are to be attributed such troubles as hemorrhoids, varicose veins, etc.

There are two classes of derangement that are caused by the mechanical defect of having the main trunks in a vertical position. First, those that are caused by the difficulty of pumping the blood up through the *vena cava*, from which arises congestion of the liver, dropsy of the heart, and other like disorders; secondly, such as are caused by the too rapid flow through the descending *cava*, from whence comes syncope or fainting. Perhaps the most striking proof of this struggle between horizontal fitness and vertical desire is to be found in the female pelvis of the human. In quadrupeds the visceral load is carried in a sling, a suspensory bandage known as the *tunica abdominalis*, fastened to the horizontal spine. This has entirely disappeared in the upper regions but yet remains to aid in supporting the lower weights in man. Still, however, most of this now bears on the pelvis, which in man has become a dish-shaped structure. In the limbs the presence of the bands of the cervical fascia are vestiges of the time when the horizontal was our normal posture. These in the lower

mammals are used to pull forward the shoulder girdle. Baker remarks their greater prevalence in a nearly unatrophied condition in some negroes. So, too, the remarkable formation of joints, whereby the erect position is maintained by the legs, without the wear and strain that would be the consequence were all of this work relegated to the muscular system, being much more complete in civilised man than in his primitive brothers, and far more so than in his anthropoid cousins, speaks of a recent adaptation in the ascending scale.

The differentiations existing between the hand of man and the higher apes is too well known to call for other than passing mention. The human hand is a rich field wherein to search for vestiges of the change that has taken place in an organ that but a brief period back was used nearly equally with the feet for support, but which now is a purely prehensile appendage. Their greater adaptation to the work recently assigned them has led to a coincident abortion of this power in the human foot, a power that is possessed in no mean degree by the monkey tribe. However, cases are not infrequent where this power is retained by man. Armless wonders there have been to whom writing, eating, and even very creditable painting have been possible, so expert have they become with their semi-prehensile toes.

The foregoing is but a hasty presentation of a few of the most marked facts which point unmistakably to the struggle that man has had and is, in a lesser degree, still having to maintain his erect position. Much more of a more intricate nature is known; but there can be no doubt all that is yet known is but a small fraction of what remains to be discovered. The whole subject of the effects of use and disuse in the parent upon its progeny is an open and yet debatable question. But before many of these yet unascertained facts can be ours we must have a more intimate knowledge of the structure of primitive races. This must not be derived from generalisations based on the study of comparatively few isolated cases drawn from exhumed remains and from savage peoples, but must be based on large and varied series from all sources.

We cannot do better in closing this *resume* than to quote the words of Mr. John Evans, F.R.S., when alluding to the pressing need that anthropology now has of immediate aid in the direction of obtaining more extended acquaintance with the yet savage or semi-civilised races. "I have made this incidental mention of this subject," he says, "rather from a feeling that in Africa, as well as in Asia and America, native races are in danger of losing their primitive characteristies, if not of partial or total extermination, and that there the anthropologist and naturalists must take the earliest possible opportunities for their researches."

(*Concluded from last week.*)

VOLUME I. OF "SCIENCE SIFTINGS"

CAN BE HAD.

Bound in Cloth and Gold, 3s. 6d. Postage 6d. extra.

Or from Messrs. W. H. Smith & Son,

and through any Newsagent.

The Index to Volume I.

may be obtained on application to the Publishers, price 2d., post free, 2½d.

Covers for binding Vol I, price 1s., post free, 1s. 2d.

Or through any Newsagent.

A SECOND OF TIME.

A second is the smallest division of time in general use, and when we consider that in one year there are about 31,558,000 of these periods, it would certainly seem as if it was small enough for all practical purposes. But, after all, a good deal can happen even in a fraction of a second. A light-wave, for instance, passes through a distance of about 185,000 miles in this length of time. A current of electricity has probably an even greater speed. The earth itself moves in its orbit at a rate of about 20 miles a second, thus far exceeding the fastest railroad trains on its surface. A tuning-fork of the French standard vibrates 870 times per second to produce the note A on the treble staff.

In scientific work, therefore, it is necessary to be able to accurately subdivide the second into many parts, and this is a comparatively easy matter. A second is quite an appreciable length of time. One can easily count four in it without hurrying, and a very little practice will enable any one to estimate tenths of a second with much accuracy.

One of the most common instruments for estimating fractions of a second is known as the chronograph, which consists of a metallic cylinder connected with clockwork so as to revolve just once in a second. The cylinder is covered with paper, and a pen is so arranged as to trace a spiral line upon the paper as the cylinder revolves under it. An electro-magnet is connected with the pen, so that when the circuit is closed and the current passes, it is drawn a little distance to one side, thus breaking the continuity of the line traced on the paper. Now if the pen is connected with a pendulum beating seconds, and so arranged that the circuit is closed at each beat of the pendulum when the chronograph cylinder is started the pen will mark a line on the paper which is continuous except at one point in each revolution, where a little notch is made in the line as the pen is drawn aside by the electro-magnet.

If the cylinder revolves accurately once a second, these notches will be exactly opposite to each other and extend in a straight line across the paper on the cylinder. By means of a key the circuit can be closed at any other instant, regardless of the action of the second-pendulum, thus making another notch in the line traced on the cylinder at some intermediate point between the notches denoting seconds. Now if the chronograph cylinder is six inches in diameter, the distance between any two second-marks will be about 18·8 inches; and as a thirty-second of an inch is a length easily measured, this distance can be readily subdivided into six hundred parts, each part corresponding to a six-hundredth part of a second.

The operation of the instrument is as follows: Suppose an astronomer wishes to record the exact time of the eclipse of one of Jupiter's satellites, for instance. He places his telescope in the proper position, starts the chronograph, and connects the pen with the pendulum of an astronomical clock, so that every second is recorded on the paper. He then places his finger upon the key by his side, looks carefully through the telescope, and at the moment the satellite disappears presses the key. A notch is made in the line at some point between two of the second-notches, and it is only necessary to measure the distance to determine the exact instant of the disappearance of the satellite, even to the five-hundredth of a second.

It is found, however, that the exact instant of the disappearance of the satellite is *not* accurately recorded. A certain small, but definite, space of time elapses before the

observer comprehends that the satellite has disappeared, and before he can will his hand to make the necessary motion to record it. In other words, the human machine works with a little friction, and any occurrence will be recorded on the chronograph a small fraction of a second after it has really taken place. This delay is known as the "personal equation." It varies in different individuals and at different times with the same individual. In very accurate observations it is an important factor, and must be carefully calculated and allowed for.

Another way of estimating minute periods of time is by a tuning-fork. Suppose such an instrument giving a note corresponding to one thousand vibrations a second. A small point is fastened to one of the prongs, and arranged as to press lightly against a piece of glass covered with a thin coating of smoke or collodion. The tuning-fork is sounded and the piece of glass drawn rapidly under it. The point traces a fine zigzag line on the glass, each angle corresponding to a vibration of the fork; and in the length of line corresponding to a second of time there will be just one thousand such angles. As the glass can be moved through a considerable distance in a second of time, the resulting line will be of sufficient length to be easily divided into thousandths of a second, or even smaller fractions by using tuning-forks of higher pitch and more rapid vibrations.

A rapidly revolving mirror is sometimes used to estimate minute lengths of time. This method is a more complicated one, and depends upon the displacement of the image reflected in a small mirror which revolves at a high rate of speed. By this method Foucault, using a mirror making from six hundred to eight hundred revolutions a second, determined the time required for a ray of light to traverse a distance of only twenty-seven feet, at the rate of 185,000 miles a second.

The time occupied by a pendulum in swinging through any portion of its arc can be easily calculated by a simple mathematical formula; and this principle has also been made use of in determining, among other things, the rate of speed at which a bullet or cannon-ball passes through the air. Two wire screens are arranged so as to form a part of two electric circuits, connected with a pendulum in such a way that when the first circuit is broken the pendulum is started, and when the second circuit is broken it is stopped again. The pendulum is raised to the highest point of its arc of vibration, and held in position by an electro-magnet. The gun is then fired, and the bullet, passing through the wire screens, breaks the two circuits in succession, and the interval of time occupied in traversing the distance between the two screens is easily determined by measuring the distance through which the pendulum has fallen.

An improvement upon this method has recently been made by a French inventor, in which a horizontal pendulum—that is, a pendulum moving in a horizontal instead of a vertical plane, like the balance-wheel of a watch when laid on a table—is used. The instrument somewhat resembles an aneroid barometer, and the pendulum is provided with a fine point as an indicator, which moves around a graduated scale. It is held in position at the zero point in the scale by a strong string, which is released by the breaking of an electric circuit by the bullet as it passes through the wire screen. The breaking of another circuit connected with a second screen instantly stops the pendulum, and the distance it has moved during the passage of the bullet between the two screens is read off on the scale. By the aid of a vernier this scale can be subdivided so as to indicate one ten-thousandth of a second—a space of time which is entirely incomprehensible by the human mind.

Small as these periods of time are, they are subject to exact measurement, and enter into the investigation of actual natural and physical phenomena. But when we contrast them with the astronomical magnitudes of time and space, we cannot but be profoundly impressed with the infinite scope of the universe. In a ten-thousandth of a second a ray of light will pass over a distance of eighteen and a half miles; and yet, travelling at this enormous rate, it requires over three and a quarter years for the light to reach us from the nearest fixed star; while, for aught that we know, the light from other and more distant stars may have been hundreds of years on its journey. The time required to form the planetary systems from the primitive nebulæ can only be expressed by a mathematical formula, our ordinary figures being incapable of indicating the number of years; but even this vast length of time is but as the ten-thousandth of a second in the history of the universe. The era of the human race is only an incident in this history as brief as a flash of lightning in a summer shower, and in our present state of existence it is hopeless to expect that we can ever comprehend the true magnitudes and relations of space and time.

SOCIAL SCIENCE.

COMMON SENSE LACKED.

Every day some new law is passed somewhere or other to protect people against the results of their own ignorance and folly; but it is comparatively seldom that we hear of any proposition of a serious or comprehensive kind to do away with the ignorance and folly which render, or seem to render, so many laws necessary. Popular education is believed by some to be doing this work about as fast as it can be done; but this we hold to be a serious error. There never was a time, we believe, when so many people were trading on the thoughtlessness and credulity of the masses as at present. The Post-Office Department spends a considerable percentage of the energy which it should devote to perfecting the mail service of the country in unsuccessful efforts to prevent the mails from being used to promote fraudulent schemes. The result, doubtless, is to more or less embarrass some swindling businesses; but as fast as one is suppressed another takes its place, and some that seem to have been suppressed have only changed their name and perhaps their base of operations.

But, in addition to schemes that are unmistakably fraudulent, there are hundreds of at least dubious character that spread their nets in the advertising (sometimes even in the editorial) columns of the press. No offer is too grossly extravagant to captivate and delude some persons who might be supposed able to take care of themselves in an ordinary business transaction. We have known a man who could write a fair business letter send five shillings in response to an advertisement which stated that, for that sum, the advertiser would send a complete suite of furniture in black walnut and crimson plush to any address, carriage paid. This intelligent gentleman was very angry because, in return for his money, he got a few toy articles made of chips and rags and inclosed in a pasteboard box about six inches long by three broad, the whole thing weighing only a few ounces. The protests which he addressed, as we are informed, to the postal authorities were conceived in a fine tone of moral indignation, though the only part which the post-office had taken in the matter had been to convey to him a most harm-

less consignment of goods. So far as we could learn, it never occurred to him to pronounce himself an ass of high degree, and not only an ass but an actual aider and abettor of fraud, seeing that it is just the silly persons who expect to get something for nothing who keep the army of cheats in provender.

This idea of getting something for nothing is indeed the main-stay and support of far the larger part of the fraud that exists in the world; and the first lesson in practical wisdom is to learn that the thing is impossible, and that nobody professes to give something for nothing, or large value in exchange for small value, except for some selfish and dishonest purpose. Why could not a special effort be made in our educational institutions, not merely to put the young on their guard against being deceived, but to call forth their contempt for all the dishonest and semi-dishonest devices which now exercise so great an attraction over the masses? Why should not the lesson be taught with iteration that the best way to get what we want is to give an honest equivalent for it, and that if this principle were more generally recognised everybody would get better value for his money or his labour than is now the case?

The promoters of fraudulent enterprises are mere social parasites; they give no value, or at least no decent value, for the money they rake in, and the real workers of society have to tax themselves that these men may flourish. As to the word-making, text-finding, plans, and devices which are so freely advertised, they ought to be beneath the contempt of all but the very weakest intellects in the community; yet how many people who cannot be placed in that category take more or less interest in such things! "With all thy gettings," said one of old, "get understanding." Doubtless he meant common sense; and, if he spoke at all in the spirit of prophecy, he probably foresaw the time when, under a state-stimulated system of education, the intellectual gettings of people would be greatly increased in number, and yet common sense be very frequently left out.

A HYGIENIC APPLIANCE.

Those with the most elementary knowledge of hygiene will not require to be impressed with the importance attending an upright and well-balanced carriage of the body. In the stooping posture the walls of the chest unduly approach, and the lungs instead of being constantly expanded and filled with pure air are inactive and fail to supply the vital craving of the system for oxygen, which can only be obtained by this means. Many diseases, notably consumption, derive their origin from lung troubles, brought about merely through the neglect to walk erect and brace back the shoulders. "Position is everything" is the finest maxim of health. There is a capital little invention which we have tried and recommended to those who suffer in this way, either through lack of caution in childhood or debility in youth, and have acquired the ungraceful and injurious stoop. It is aptly termed the "Invigorator," and is supplied for either sex, in the one case as a corset, in the other as a belt. Mr. Reast, 15, Claremont, Hastings, supplies these appliances, and as he will send them anywhere on approval, we think he gives efficient proof of his faith in the "Invigorator."

If you have an idea for a patent, write to the Editor of SCIENCE SIFTINGS, giving the outline of yonr scheme. The communications will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

HELPFUL HINTS.

WHY AN ATMOSPHERE?

E. P. SMITH.—The reason why the atmosphere does not fly off from the earth into the "vacuum" surrounding is simply that the force of gravitation acts between the earth and every particle of air. It is not considered to be impossible that a few particles of our atmosphere may occasionally be thrown off into space. But for the most part it is certain that gravitation holds the ocean of air in equilibrium almost as perfect as that of the oceans of water.

ASTRONOMICAL WORK.

S. ROBINSON.—(1) For studying Saturn's ring we can recommend you a 2½ in. o.g. astronomical telescope as supplied by Mr. George Airy, of 42, Gray's-inn-road, W.C., or any other respectable optician. (2) The book you have is one of the best possible.

ATMOSPHERE AND ROTATION OF THE EARTH.

J. D. MAYSON.—The reason why the atmosphere is so completely carried round by the earth's rotation is that there is considerable friction between the surface of the earth and the overlying air, and that there is also friction between the individual particles of air, but practically none between the atmosphere and the free ether of space external thereto.

CLOVER TEA.

D. ELEY.—Any herbalist can supply you with clover if you do not care to gather it yourself in the country. Fill a cup with the clover; pour on boiling water; and strain, after standing ten minutes to "draw."

THE DISCOVERY OF NOAH'S ARK

E. L. GARBETT.—We must refer you to the article, where we have fully stated our authority in the matter, and at the same time disclaimed any responsibility for the remarkable statements set forth. If any further information on the subject is forthcoming it will appear in our columns. See "Gleanings of the Globe" in current issue.

MISCELLANEOUS.

S. L. WILTON.—Readdress your letter to the Editor of *Photography* Hertford-street, Coventry.

FRANK H. WOOD.—We have sent the specimens for examination by a microscopist and will report in due course.

GUY H. H. DAWN.—You will observe by our first paragraph that we have adopted your suggestion.

ALFRED MORRIS.—Letter and book received. Thanks for both. Review will appear in due course.

ALFRED. T. STORY.—We are over-supplied at present. Your kind offer will be considered at a future date.

RE HARNESS.—Correspondents who have favoured us with communications on this matter are thanked, and assured that we by no means intend to allow the scandal to die out.

LT-COL. ROGERS.—(1) The reason is that the sun's right ascension does not exactly equal two hours for each of the signs of the zodiac. (2) We regret being unable to give any simple formulæ such as you desire. Any particular question as to the best time for observation of either of the planets we will be pleased to reply to as far as possible.

W. J. LANCE.—Roscoe's "Elementary Lessons" is the best book for beginners in chemistry. Price 4s. 6d. from Mr. George Airy, of 42, Gray's-inn-road, W.C.

ARTHUR DENTON.—Mr. J. B. Verity's "Electricity up to date" can, we believe, be obtained from the author, at 137, Regent-street W. There is nothing in the book that you should have the least difficulty in understanding.

H. BOTOMWORTH.—Thanks for your letter. We are aware that Noah's ark was said to be have been discovered many years ago. The report, however, proved to be unfounded. We regret that the "spider" paragraph, to which you draw attention, gained admission to our columns. It was sent as original by a contributor in whom confidence was reposed.

W. TURNER.—No special system of lighting trains by electricity is employed exclusively in Belgium or in any other country that we know of. Many experiments have been tried with different dynamos and storage batteries of which there are a number in use, but no advance over our English practice has been made in Belgium that we are aware of.

F. A. VELSCHOW.—Prof. Langley is an American author, and we regret having none of his publications on our shelves.

SENEX.—The title you propose is too lengthy,

W. H. JONES.—We hear of thousands who have been similarly defrauded. We hope you will have plenty of satisfaction presently.

*** Many replies to correspondents are unavoidably crowded t. They will be published in due course.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.,* 3 *months,* 1*s.* 9*d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.

'Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C

Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, SEPTEMBER 24, 1892.

ELECTROPATHIC BELTS.

We have received an intimation from Messrs. W. H. Smith and Son, and Messrs. Willing that if we publish any further damaging statements as to the uselessness of Mr. C. B. Harness's so-called electropathic belts, they must discontinue the sale of the paper. These firms have wisely adopted this course owing to communications received from Mr. Harness. We are not surprised that Mr. Harness has thus endeavoured to stay our hand, although we should have preferred that he had adopted a more obviously appropriate method. However, as the two firms to which we have referred are the most important newspaper distributing agencies in the kingdom, we are compelled to abide by their decision. Any other course would be useless, as the paper, under these circumstances, could not then be read over about three-fourths of the kingdom. However, the issues of August 6, 13, 20, 27, September 3 and 10, in which our disclosures appeared, may still be had on application to the publisher; and as we have said enough to guard our readers against purchasing these electrical appliances, we now leave the matter for the present.

SCIENCE NEWS AND NOTES.

"Daylight comes a dream from space.
Alas! how short its stay.
Yet light remains for ever here,
To guide Truth on its way."—ANON.

We Have Been in the Throes of Consideration

for many weeks past over our new title, but we are now pleased to be able to inform our readers that our final selection has been made. The title of our choice is—

SIFTINGS.

The Tit-Bits of Current Thought
on
Health, Science, Food, Invention, Literature, and Sociology.

We owe the suggestion for this title to Mr. Henry W. Tice, of 70, Macfarlane-road, W., to whom we have forwarded the promised award of one guinea. Our reason for the selection will be obvious. The change is not too radical, while it accomplishes all we require. "Siftings" absolutely explains our undertaking. We class ourselves with *sifters*, or lamellirostral birds,—so named because they sift or strain the mud out of their food by the lamellæ of the beak—because we intend to thus sift the matter we place before our readers, leaving them only the useful and wholesome remnants. In addition to this we shall continue sifting all matters that may assist our readers to avoid the snares that beset them on every side in the form of quack remedies, adulterated foods, and poisonous luxuries, etc. Before leaving this subject, we desire to thank all who have so ably assisted us in our search for a new title, to apologise for the trouble we have given many thousands of unsuccessful contributors, and to express our regret that we cannot afford to award each of them a guinea apiece, and our hope that they will help us all they can with SIFTINGS by introducing it to their friends.

"Light, More Light,"

the pathetic death-cry of Goethe, may, after all, have had a significance in the physical sense. According to the dictum of Dr. Konigswald, of Munich, the effect of light, and especially of sunlight, upon the cholera and fever microbe is remarkable. Dr. Konigswald has just made a series of experiments with water which he had previously impregnated with the bacilli-laden sputæ of choleraic and typhus patients. With this water he filled two vessels. One of these he placed in a dark cellar, where he left it standing for about two hours. The other he exposed during the same time to the direct rays of the sun. When the doctor returned to the vessel placed in the cellar he found on examining the water that the bacilli had multiplied to an extraordinary degree. In the water contained in the other vessel, however, upon which the sunlight had had free play, absolutely no traces whatever were to be found of bacilli. The hint might well be taken by many a prudent housewife, who for fear of discolouring the precious draperies, but too often denies the beneficent sunlight admittance into the jealously-darkened sanctity of the drawing-room, so that the myriads of dust particles, floating about amid the gloom, should, forsooth, not have a chance of breeding the germs whence infection comes.

Compulsory Cremation

is, we learn, being strongly agitated for by the German papers where cholera has been the cause of death. The little that is to be said against cremation—we refer to the noxious gases and possibly unconsumed matter that may find its way into the atmosphere—is certainly counterbalanced by the good that must result from the absolute destruction of disease germs. In our last issue we referred to the experiments of some French scientists, which conclu-

sively proved that, bury a corpse no matter how deeply, the disease germs will be again brought to the surface by earth worms to respread the contagion. All this is of the utmost importance, in view of the constantly occurring cholera epidemics.

The Way to Stamp Out Cholera

—we do not refer to the existing epidemic, but in perpetuity —is to adopt the principle of prevention. As Sir Spencer Wells has pointed out, the destruction of the bacilli found in the bodies of cholera patients has long been regarded by most bacteriologists as one of the most necessary measures to prevent the spread of the disease. Now there can be no doubt that fire is the swiftest and most effective mode of destroying the bacilli. We have, however, to combat the atmospheric argument already advanced, and the medico-legal opinion that if cremation became general it would be used as a means to obliterate the traces of crime. We consider, however, that precautions could be taken to overcome the last objection; and as for the former, the mischief might be limited by confining the legality to cremate a body to the victims of epidemic diseases, such as cholera, scarlet fever, typhus fever, and diphtheria. Anyhow, by enforcing cremation we should, with the evidence we have before us, decidedly be selecting the lesser of two evils.

The Scarcity of Our Food Supply

might probably be mended if it were not for the remarkable prejudices existing in the human mind against certain forms of diet. We have the strange anomaly of reasoning beings, swallowing with relish the flesh of swine, ducks, eels, etc., and turning up their noses with refined disgust at the thought of consuming comparatively clean feeding insects, etc. A learned professor once, while lecturing on entomology, took up in his finger and thumb a grasshopper and chewed it down with relish, and told his students that any one swallowing the glutinous mass of the oyster had no right to look askance at his singular choice of diet.

The Snail Has Been an Article of Food

for many years in certain regions, served, as Hans Christian Andersen's snail boasted, on silver dishes; but, perhaps owing to our prodigal abundance of rich food, it has never been adopted by us, although there seems to be no more reason for a prejudice against it than against prawns, shrimps, or any mollusc. In France, snails are a favourite dish, and are eaten by many good Catholics as fish in seasons of fast; a nourishing soup, supposed to have peculiar excellence for the consumptive, is also prepared from them, and they are boiled in milk for the same sufferers. In the old days of the Roman epicures they were cultivated by being fed on fattening food, but their natural food is chiefly vegetable. As there are many more than a thousand specimens of them, and they are found nearly all over the globe, it is a pity that any hostility to them as an article of diet should not be overcome.

The Beating of the Pulse

is certainly one of the most providential features in the physiology of man from the medical point of view. Without this indicator of the physical condition, the diagnosis of disease would be rendered extremely difficult. It is, however, worthy of note that even this useful feature has its irregularities. Although the average pulse of a healthy man in the prime of life is about 72 per minute, this average is subject to almost innumerable variations, depending upon the time of day, upon the meals, upon the position of the body, whether lying, standing, or walking, also upon the state of health and the amount of exercise taken. Ninety beats and upward to the minute are counted a quick pulse, but some persons in perfect health have a pulse no more than 40 to the minute. The pulse is also influenced by age. A curious statement was some years ago prepared by a physician, showing from a great number of cases the average pulse at different ages. At birth, the pulse is shown to be about 136; from 5 to 10 years at 80; from 10 to 15 years at 78; from 15 to 20, 69; from 25 to 30, 71; from 30 to 50, about 70. It is a general opinion, expressed both in poetry and in prose, that the pulse of age is slower than that of youth. The leading medical authorities declare the reverse to be true, and that this popular idea has no foundation in fact.

Spurious and Injurious Baking Powders

were exposed in our columns many months ago, when we fully set forth the dangers that were likely to arise from their use. We are, therefore, extremely surprised to find the magistrates in a case just heard, in which the evidence proved that the powder in question contained 35·5 per cent. of alum, deciding that baking powder was not a food, and that adulterated powder was, therefore, not sold to the prejudice of the consumer. The summons was for this reason dismissed. The defence urged that the chemical process which followed on mixing the powder with the dough rendered it entirely harmless. The chief use of baking powder is to give porosity to the bread, and even without arguing that baking powder is a food, it is a moot point whether the powder in question could not be regarded as being sold to the prejudice of the purchaser. It consisted of alum and bicarbonate of soda. These substances when moistened interact, carbonic acid gas escapes, and there remains a residuum of sodium sulphate and alumina.

The Double Decomposition

results in the formation of a salt of strong purging qualities—viz., Glauber's salt—it is important to consider what is likely to be the action of the newly-formed alumina. It is well known that alumina when precipitated in the presence of certain soluble matters will render them insoluble. This is especially the case with soluble nitrogenous matters, or, in other words, most forms of food. Further than this, alumina combines with soluble phosphates — the chief bone-forming constituents of food — to form insoluble phosphate of aluminium. Surely, in the light of these facts, it is seriously to the prejudice of a purchaser if, when he buys a baking powder, he receives one which is calculated to reduce very materially by reason of the nature of its ingredients the food value of his "staff of life," by rendering both the nutritious and the bone-forming constituents in it insoluble and indigestible. If baking powders must be used, we agree with the *Lancet* in strongly deprecating the use of alum in their composition, especially as there are other comparatively inert and equally effective agents procurable. When a baker uses alum in his bread or flour, proceedings are successfully taken against him under the Food and Drugs Act, and it is reasonable to expect that the same Act should protect the purchaser against alum introduced into his bread in any other form, not excepting that of baking powder.

The Left-Handed Cat

to which we referred in our last issue, has produced quite a shower of inquiries as to whether left-handed people possess equal strength and adaptness with right-handed people. As

far as our knowledge goes, left-handers are notably of more than the average strength and much more than the average accuracy of the eye. Leonardo da Vinci and Hans Holbein were left-handed. Left-handed batsmen are noted for hitting, left-handed fielders for smartness, and left-handed bowlers are generally fast. We know a bat whose back play is a perpetual source of astonishment to the spectators. But now comes in a factor of unknown quantity. One would think that where conventional usage has obtained from the left-handed one particular set of motions for the right-hand, it would be one requiring but average skill. But is this so? The three arts of cricket are distributed among left-handed people in the most arbitrary and apparently inconsistent manner; most of them bat left-handed, but many bowl with the right, and some bat with the right and bowl with the left. No doubt it would be found that, on the whole, those actions requiring the utmost nicety and the greatest accord between eye and limb are allotted to the superior hand; again, spontaneous gestures and unstudied actions would also be performed by the same hand.

It is a Remarkable Fact

that with the majority of people the neglected left hand is not in mere strength inferior to the right. We have heard truly right-handed people actually declare that their left hand is the stronger, and from our own experience we know this to be the case. This may be from the mechanical advantage and better balance of the body, the right side being heavier, or it may be due to the large muscles of the unused arm being less hampered by the development of other muscles. It is difficult in these cases to say which is the "right" hand, for the fact that the unused arm is the stronger does not imply ambidexterity, nor can we justly give the precedence to strength over dexterity.

Artificial Rain Making

has now received its death blow from the qualified and guarded official report just issued by its chief exponent, General Dyrenforth. It bears out exactly what we stated from the very commencement, and we take some credit to ourselves for having adopted what was an almost unique position with regard to the question. General Dyrenforth gives the following as his most successful test:—"The firing ceased about 11 p.m., the atmosphere at that time very clear, and as dry as I have ever observed it. At about three o'clock on the following morning—August 25—I was awakened by violent thunder, which was accompanied by vivid lightning, and a heavy rain storm was seen to the north—that is, in the direction towards which the surface wind had been steadily blowing during the firing, and hence the direction in which the shocks of the explosion were chiefly carried. The rain continued falling heavily over the entire north half of the ranch for about two hours. Only the edge of the clouds passed over the ranch-house, however, so that the rain there was slight; but Mr. Rannells, manager of the ranch, an experienced ranchman, and others of the party, and I, estimated the rain-fall to be not less than one inch, and probably as much as an inch and a half, on the north pastures less than two miles from the house." It will be manifest even from this presumably prejudiced account, that the clouds were brought up by the wind in the usual manner, and that the shocks had nothing to do with their collection.

This Most Successful Experiment

cannot be claimed, even by the most ardent advocates of the artificial rain theory, to promise anything at all—and how about the other experiments? Speaking of them, General Dyrenforth says:—"The few experiments which have been made do not furnish sufficient data from which to form definite conclusions, or evidence upon which to uphold or condemn the theories of the artificial production or increase of rainfall by concussions. Experiments extending over a period of only a few months can scarcely be sufficient. It is only by a large number of tests, with accurate noting of conditions and occurrences, that definite conclusions can be reached; and if then it be ascertained to be a certainty that rainfall will be induced by explosions, that such production of rainfall can be reduced to an art, so as to effect precipitation at a predetermined place. What has been done so far is altogether preliminary; but, with the benefit of experience gained, I hope that the subject will be pursued." The General is very cute, however, for he now disclaims having propounded the theories on which the experiments were based. This is how he tells the United States Government he understood his instructions: "Without any theory or theories on the subject myself, I understood your appointment to mean that I was to consider and formulate, and adopt or devise, the most practicable or reasonable means to ascertain whether violent and sudden motion or concussions, produced upon the air by explosions, can have any effect towards rainfall." The circumlocution is good, and the General is wise to disclaim all responsibility for having blown so many almighty dollars—not almighty in this matter, however—into the, air.

Space of Four Dimensions

recently formed the subject of a query in another column. A correspondent now inquires the utility of such a query. We may say that, as far as we can see, the question of a possible fourth dimension of space is only of interest in connection with the various psychical phenomena, more commonly known as "spiritual manifestations," which, if they actually occur, could, in many cases, be rationally explained by such a theory. In a four-dimension space a knot could be tied or untied in a cord with both ends fastened together as readily as we can now do so in one with both ends free. A hollow ball could be turned inside out as easily as can a thin rubber hoop under the usual conditions. A four-fold being could step out of our space at any point and enter it at any other point; and the perceptive faculties of such a being would be so vastly increased that he could be truly said to be living another and distinct life or form of existence, which would be as far above our present life as that is superior to the life of an amœba or bacterium. In fact, if our minds were capable of fully developing and comprehending this conception of four-fold space, it would be hard to say how far it might not lead us. The subject is a fascinating one and worthy the attention of the deepest philosophical thinkers.

As the Universe Manifests Itself

to our senses with our present knowledge we can perceive but three dimensions, or directions in which matter can be extended, and a fourth dimension seems almost beyond the bounds of possibility. Still, we can imagine a being living in a universe of one or two dimensions and incapable of conceiving any forms more complicated than a line or a plane surface; and it is perhaps not beyond the bounds of possibility that, if the human mind were developed to a higher degree, our conceptions of the nature and laws of the universe might be entirely changed. At present the question is a purely speculative one, and not susceptible of mathematical proof in either direction. Nevertheless, as we have already said, it is decidedly worthy of inquiry.

GLEANINGS OF THE GLOBE.

THE Gatling gun was the work of Gatling, 1861.

BAROMETERS were invented by Torricelli, 1643.

BOMBSHELLS were first made in Holland, in 1495.

THE world consumes 4,000,000 steel pens daily.

THE first almanac was printed in Hungary in 1470.

THERE are nearly 3,000 stitches in a pair of hand-sewn boots.

THE Æolopile, a steam engine, was invented B.C. 241 by Hero.

IN 1720 Stephen Gray discovered that electricity acts at a distance.

DUFAY originated his theory of vitreous and resinous electricity in 1733.

BOSE introduced a metallic conductor for the electric machine about 1733.

PLINY, A.D. 60, described a boat run by a "pot of hot water and wheels."

HERO, of Alexandria, B.C. 260, described machines for utilising steam power.

GLASS globes for generating electricity were used by Newton and others, about 1675.

THE quantity of air a man breathes in twenty-four hours would fill seven hogsheads.

JAPAN has no fewer than 700 earthquake observing stations scattered over the empire.

IT is said that a bar of iron, costing £1, will produce £60,000 worth of mainsprings for watches.

A WASH made of witch-hazel and cocaine is said to be a cure for hay fever. It is to be applied to the nasal passages when the attack comes on.

THE wild potato vine (*I. pandurata*) sometimes has a root that attains the size and occasionally the form of a boy's body, and weighs thirty-five pounds.

ROGER BACON, about 1280, anticipated application of steam power to navigation. Later on he invented a steam engine, and was imprisoned for sorcery.

THE first railroad in India to be built and controlled entirely by natives has been sanctioned by the Indian Government. The line will be about 30 miles long, in the Hooghly district.

BLOOD travels from the heart through the arteries ordinarily at the rate of about 12 inches per second; its speed through the capillaries is at the rate of $\frac{3}{100}$ of an inch per second.

CHLORINATED soda, a correspondent writes, will remove every suspicion of inkstain from linen almost instantaneously. The remedy to be efficient must be applied immediately after the accident.

THE descendants of a single wasp number as many as 30,000 in one season. November is the fatal month which kills them all off, except two or three females, on whom depends the perpetuation of the race.

IT is said that a Paris laundryman has discarded all soaps, sodas, and boiling powders. He merely uses plenty of water and boiled potatoes, and can cleanse without employing any alkali, the worst soiled linens, cottons, or woollens.

HOT alum water is the best insect destroyer known. Put alum into hot water and boil until dissolved, then apply the water with a brush to all cracks, closets, bedsteads, and other places where insects may be found. Ants, cockroaches, fleas, and other creeping things are killed.

IT is said that every telegraph pole in the remote country districts of Norway has to be continually watched on account of the bears. These animals have a mania for climbing the poles and sitting on the cross-beams, swaying backward and forward until the pole finally falls down.

THE floating island in Satawga Lake, near the town of Whittingham, Vt. (U.S.A.), is justly regarded as one of the greatest curiosities in the Eastern States. It contains about 100 acres of fertile land, and is sometimes found in one quarter of the lake and then again in another.

FOOT soreness must be guarded against by the mountain-climber and pedestrian. Strong boots and good stockings do much to obviate it; also soaping the stockings, or sprinkling them with bismuth and oxide of zinc, and on the first appearance of signs of irritation, the *Lancet* recommends a weak whisky lotion.

THE theory of the apparent enlargement of the sun and moon at the horizon is that their light passes a greater distance through the atmosphere than at higher elevations. This causes an increased refraction, tending to enlarge the solar and lunar image, and acting as a great spherical lens at a near distance at noon and a greater distance at the horizon.

AN extraordinary grotto, which is exciting the interest of geologists and mining engineers, was recently revealed at Taverny, owing to an explosion. This subterranean gallery, with walls polished as if by water, is some 1,500 ft. in length, and ends in a great chamber, about 40 ft. in diameter and 6 ft. in height. Many are the conjectures as to whence and when the watercourse, which, it would appear, once dug this cavity, came.

WE have just received a copy of Mr. W. McQuhar's "Practical Technical Instructor"—a complete manual of the arts and crafts, containing over 1,000 valuable recipes, many of which are here published for the first time. This book is equally indispensable to the amateur and artisan, to whom it is likely to be of greater practical utility than many other compilations published at other times at the price. It is a substantial and well illustrated crown 8vo., and is a marvel of cheapness at 1s. 2d. post free.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not satisfactorily replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 47.

205.—What is the explanation of the explosion of gunpowder?

Gunpowder consists of a mixture, in somewhat varying proportions, of charcoal, sulphur, and nitre, or saltpetre. The nitre contains a considerable proportion of oxygen; and the explosive power of the gunpowder depends upon the rapid combustion of the charcoal and sulphur at the expense of this oxygen contained in the nitre. The combustion produces a temperature of about 2,200° C., at which the gaseous products (principally carbonic acid and nitrogen) are, of course, in a very greatly expanded condition. In fact, the pressure of the liberated gases at the moment of explosion reaches about 42 tons to the square inch.

206.—What is the connection between the trade winds and the rotation of the earth?

Since the earth revolves about an axis passing through the poles, the equatorial portion of its surface has the greatest velocity of rotation, and all other parts less, in the proportion of the radii of the circles of latitude to which they correspond. But as the air, when relatively and apparently at rest on any part of the earth's surface, is only so because in reality it participates in the motion of rotation proper to that part, it follows that when a mass of air near the poles is transferred to the region near the equator by an impulse urging it directly towards that circle, in every point of its progress towards its new situation, it must be found deficient in rotatory velocity, and, therefore, unable to keep up with the speed of the new surface over which it is brought. Hence, the currents of air which set in towards the equator from the north and south must, as they glide along the surface, at the same time lag, or hang back, and drag upon it in the direction opposite to the earth's rotation, *i.e.*, from east to west. Thus these currents—the trade winds—which but for the rotation would be simply northerly and southerly in direction, acquire, from this cause, a relative direction towards the west, and assume the character of permanent north-easterly and south-easterly winds.

207.—What are Purkinje's figures?

Stand in a dark room with a lighted candle in the hand. Shutting the left, hold the candle very near the right eye, within three or four inches, obliquely outward and forward, so that the light shall strongly illuminate the retina. Now move the light about gently, upward, downward, back and forth, while you gaze intently on a white-washed wall or a white sheet opposite. Presently the field of view becomes dark from the intense impression of the light, and then, as you move the light about, there appears projected on the wall a shadowy ghost-like image, like a branching leafless tree, or like a great bodiless spider with many branching legs. This is Purkinje's figure. And it is an exact but enlarged image of the blood vessels of the retina.

208.—How can arsenic be detected in wall paper?

The paper should be saturated with chlorate of potash solution, dried, set on fire on a suitable plate, and instantly covered with a bell glass. The ash together with the plate and bell glass is treated with cold water. A piece of sodium amalgam is put into the resulting arsenical solution and the gas then evolved is conducted through a piece of glass combustion tube. The tube is strongly heated near that end at which the gas (containing arseniuretted hydrogen) is introduced, and in this way the gas is decomposed, so that a "mirror" of metallic arsenic becomes deposited upon the cooler portion of the interior of the glass tube.

209.—What proportion of impurity gives water a perceptible taste?

Dr. F. de Chaumont states that sodium chloride (common salt) is tasted when it reaches about 75 grains to the gallon of water. Sodium carbonate when it reaches 60 grains; potassium chloride 20 grains; magnesium chloride 50 grains; calcium sulphate 25 grains; calcium carbonate 10 grains; iron 2 grains. Iron is, therefore, the only common mineral impurity that can be tasted when present in exceedingly small quantity. Perfectly dissolved animal matter is frequently quite tasteless. On the other hand, the taste of good drinking water is due entirely to the gases dissolved.

210.—What magnifying power is requisite to discover animalculæ in ordinary drinking water?

The detection of the minute bacilli which alone are found in fresh drinking water requires a very high magnifying power. The cholera bacillus corresponds in point of size, although fortunately not in frequency, with those referred to, and this appears of about three-sixteenths of an inch in length when examined under a magnifying power of 1,200 diameters. A magnifying power of about 700 is the lowest that can be recommended for bacteriological work.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

217.—Why is it desirable, when writing, to allow the light to fall over the left shoulder?

218.—What is the advantage of mercury over every other liquid for barometers and thermometers?

219.—What is the venom of a snake?

220.—Is there any difference between the teeth and the bones of the body?

221.—What is colour?

222.—Why does soda water counteract the effects of alcoholic liquors?

VOLUME I. OF "SCIENCE SIFTINGS" CAN BE HAD.

Bound in Cloth and Gold, 3s. 6d. Postage 6d. extra.

Or from Messrs. W. H. Smith & Son, and through any Newsagent.

The Index to Volume I.

may be obtained on application to the Publishers, price 2d., post free, 2½d.

Covers for binding Vol I, price 1s., post free, 1s. 2d.

Or through any Newsagent.

MORE ELECTRIC-BELT-QUACK METHODS.

Very few people gain an insight into the methods of the inner working of the so-called medical electrical establishments. Those who do so, usually for their own sakes, are not prone to reveal what they learn. There is, however, one man whose courage led him, some years since, to investigate the secrets of an electrical scientist's sanctum. The name assigned to this scientist by the investigator was Autolycus, the rogue in a "Winter's Tale." The name of the investigator was William Lynd, M.S.T.E. ,F.R.M.S., to whom all honour is due.

Mr. Lynd had heard that this "eminent consulting medical electrician" was in want of a lecturer on electro-physiology and electro-therapeutics. We now give, in his own words, his remarkable experiences. He says:—

"I had heard of Autolycus through the advertising columns of the daily newspapers, and my attention had often been attracted by the elaborately fitted-up establishment, through whose portals so many dupes have entered. My first impulse was to look through the pages of our society's list of members. No such name as Autolycus was to be found; but I argued thus: 'This man may not belong to the Society of Telegraph-Engineers and Electricians, but that is no reason why he should not be clever in his particular branch of the science; and surely,' I argued, 'no person would have the audacity to style himself eminent unless he had some claim to the title!'

"After nearly a fortnight's deliberation, I determined to wait upon the great Autolycus, and almost trembling with a sense of my own littleness and the eminent electrician's greatness, I approached the elegantly-furnished sanctum of the 'distinguished' person now under notice. My first interview was not quite satisfactory; but the apparent frankness of the man was striking in the extreme. Autolycus endeavoured to impress me with a sense of his marvellous aptitude for the commercial side of his 'profession.' He asked me to examine his apparatus, 'and,' said he, 'if you find that we are on the wrong tack, put us right, and we shall be very much obliged to you. My electrical knowledge may be put into a nutshell.'—Would it not be lost altogether in so large a receptacle?—'I believe in attending to the commercial part, and *selling the goods*. If you will accept the appointment I offer you, you can experiment in a large laboratory which shall be placed at your disposal, and no expense shall be spared whenever you find that something can be developed or perfected.'

"Of course, I soon discovered that Autolycus had not the slightest knowledge of either anatomy, physiology, electricity, or pathology. He did not know the names of electrical units! Such lamentable ignorance staggered me; but I fancied that the man meant well, and feeling his incapacity, he intended in future to stick to the commercial part, leaving the electrical section to a qualified electrician. I imagined that if I accepted the appointment Autolycus would not interfere with my department; and, acting upon that supposition, I sent my delicate testing instruments to the said establishment, and for the first time in his life the 'eminent' gentleman gazed upon a Thomson reflecting galvanometer, a condenser, discharge key, standard cell, and other pieces of apparatus used in electrical testing. Instead of taking an interest in these beautiful instruments, Autolycus made fun of them, and compared them with playthings. He said that such things would not sell the goods, and he left me feeling a contempt and loathing which would be difficult to describe.

"This was not all. No sooner had I accepted his offer than he ridiculed any suggestion as to the improvement of the apparatus then being supplied to the public. I told Autolycus that his belt was useless, but that it was possible to construct flexible cells which would give a current of electricity, using the belt as a vehicle. In the most insulting style he told me that he would not have his 'inventions' interfered with. The public were perfectly satisfied, and why should he put himself to extra expense. The public did'nt want science. He did'nt want science. 'Sell goods,' was his motto, and he meant to stick to his own system.

"Here was a nice place for a professional man to find himself in. I was bound to deliver a few lectures on electro-physiology for this 'snapper-up of unconsidered trifles,' but I determined to get out of his clutches with as little delay as possible. The 'consulting electricians' attached to the establishment were as innocent of the laws of electrical science as Autolycus himself; but one or two very earnest fellows expressed themselves willing to learn anything I offered to teach. One day, as I was showing a member of the establishment the way to test a battery, Autolycus told the 'electrician' to find something better to do, and calling me aside, he expressed his disapprobation, and said that I only embarrassed his staff! Autolycus was seldom seen by the public. He was generally engaged in the advertising department, and whoever happened to be disengaged when a patient called was the 'eminent consulting medical electrician'—Autolycus for the time being. As I was only obliged to deliver a lecture on medical electricity, I stayed away from the place when I found out the system of humbug that was being practised, merely arriving at about 2.45, and leaving again soon after four.

"I discovered that, although genuine electrical appliances were put upon my lecture table, any rubbish was sold to the public, and any nonsense was talked in order to facilitate a sale. 'The consulting medical electricians' were paid small salaries and commissions, which made them look sharp after the sales. Autolycus preferred drapers' assistants, because, to use his own expression, 'They are pushing men.' I once heard the manager, who was nothing more than a good shopman, say, 'I have taken £50 from one customer this morning for electropathic appliances.' The belts yielded enormous profits. There was nothing electrical about them. The three guinea belt, Autolycus himself confessed, cost three shillings, which was, I should say, allowing a margin of twenty-five per cent. About twopence more converted a three guinea into a five guinea belt. In my lectures I referred to the labours of Sir William Thomson, Prof. Hughes, Erb, and other eminent men. This caused Autolycus great annoyance. 'Why should you advertise these fellows?' he would say. 'Don't talk about Sir William Thomson. Tell the public about the great Autolycus, the friend of suffering humanity. Don't talk about general electricity, but say that it is *my* special kind of electricity that cures disease.' This was too much; but I had to finish the course of lectures according to agreement, although I was not compelled to talk the nonsense Autolycus suggested.

"Just before the last lecture I gave Autolycus notice in writing that I could not begin another course. He asked me if I would lecture in the country for him. I demanded a fee which I knew he would not pay, and thus ended my six weeks' experience of a quack medical electrical establishment. My services had been obtained by false representations, for I was told that whatever was wrong electrically I was to remedy, and I firmly believed that there was an excellent opportunity to found a splendid institution

for the development of electro-therapeutics. The moment the engagement was settled, Autolycus showed himself in his true colours. He was the sort of man who, seeing two roads, one straight and the other crooked, would choose the tortuous path. His ignorance of his own language was lamentable, while his knowledge of electrical science was on a par with that of the Irishwoman, who thought she could send a new pair of boots by telegraph to her son in the Crimea. None of the many books and pamphlets bearing the name of Autolycus were written by that ignoramus. The 'eminent' gentleman sucked the brains of others, and dressed himself in borrowed plumes. Such is an imperfect and uncoloured sketch of a man who, using electricity as a cloak, drives a roaring trade, while many professional men have to struggle hard for a bare existence."

MR. HARNESS'S INVITATION TO "SCIENCE SIFTINGS."

We have received the following invitation from Mr. Harness :—

The Electropathic and Zander Institute,
52, Oxford-street, London, W.,
Mr. C. B. Harness, President.

The pleasure of a visit from you at any time most convenient to yourself is requested with a view to your criticising and reporting upon the method and value of the Electropathic treatment of disease as practised at this Institute.

To the Representative of
"Science Siftings."

OUR INVITATION TO MR. HARNESS.

The following is our reply to Mr. Harness :—The Editor of SCIENCE SIFTINGS presents his compliments to Mr. Harness, and begs to acknowledge the receipt of an invitation to inspect the Electropathic and Zander Institute, with a view to reporting on the value of the methods practised there for the treatment of disease. Mr. Harness has no doubt already seen the criticisms on his Institute that have appeared in SCIENCE SIFTINGS, and since the Editor is already acquainted with Mr. Harness's methods, he sees no reason for further inquiry into their merits, but he places his columns at Mr. Harness's disposal if he desires to controvert any of the statements that have been published. The Editor trusts this invitation will meet with Mr. Harness's acceptance.

THE FIRST ICE MACHINE.

The first ice machine was constructed and patented (No. 6662) by Jacob Perkins in 1834. This machine worked on the system of compressing a suitable gas to the liquid state, the vaporisation of the liquid attended with a large absorption of heat, and the recompression of the same. The gas used by Jacob Perkins was a kind of ether prepared from the destructive distillation of caoutchouc. The first machine was erected on the canal bank at Camden Town, where the first bit of ice was made by Sir Frederick Bramwell (then a oy), and carried by him in a blanket to Jacob Perkins' ouse to show the inventor the result of his experiments, he eing unfortunately ill in bed at the time.

JOVE'S THUNDERBOLTS.

Of all the wondrous phenomena of nature, nothing inspires such admiration by its beauty and grandeur, or such dread by its awful power, its suddenness and mysteriousness of its terrible tricks, as lightning. Neither fire nor flood, gale, volcano, nor earthquake combines in its manifestation such elements of fascination and horror to the intelligent observer. Since Benjamin Franklin, with his kite experiments, demonstrated that these dazzling and destructive thunderbolts were electrical in character. Science has continued to study their nature and habits, but without thoroughly unlocking their secrets or telling man how with certainty to defend himself against their attacks. Owing to elaborate newspaper descriptions, photography, and to the researches in electricity for industrial purposes, however, gratifying progress has been made in the last ten or fifteen years, and it is reasonable to hope that the present generation will yet know much more than it does now about these strange manifestations of force. In the present article an attempt has been made to bring together a number of representative incidents, serving to illustrate some of the more manifest traits of lightning.

The effects upon the human person of a stroke of lightning naturally have the first place in the investigator's interest. The degree of injury sustained varies all the way from a slight stunning to instant death, the differences arising, no doubt, in part from the varying amounts of electric force in the discharge, the greater or less portions of the current received by the individual and the conductivity of his clothing and other articles upon his body or near by. Often a small hole is bored in the skull, but no other mark is visible. Again, the person is shockingly burned or dismembered, and even disemboweled. Sometimes the hair is badly singed, and it has also been turned white or shaved off instantaneously.

In numerous cases the skin is seared and discoloured along a tortuous line, from shoulder to foot, or perhaps only for a few inches. Instances can be cited of these tracks being red and blue and black, and of the whole body turning black. A negro's arm, on the other hand, has been changed to white. Blindness, deafness, paralysis, total or partial, are among the most familiar consequences of a stroke. Keys, coins, watches, and watch-chains, metal cartridges and eyeglass frames have been more or less damaged, while the person that bore them was almost uninjured. The clothing, including boots with iron pegs and rubber shoes, has often been torn to pieces, with or without injury to the wearer. The brass eyelets were torn out of a man's shoes, but he felt only a slight and harmless shock.

Places of danger during a thunderstorm include the neighbourhood of a tree or other high wooden object like a flag pole. There are isolated instances of a man being struck in an open place or in a rowing-boat out on the water, but the stories of death from taking refuge under an oak or other tree are nearly twenty times as numerous. The upright masts of vessels also attract the lightning. A mere pitchfork or umbrella in the hand has seemed to invite the lightning, in several instances the metal as well as the erected point exerting an influence. There are reports of fatal strokes to men and animals that were in contact with a wire fence. These are to be received with a grain of salt ; yet there is no harm in avoiding such associations during a storm. Open fireplaces have in a few instances appeared to encourage the descent of a discharge by way of the chimney.

Possibly this was due to a current of air downwards. However this may be, nearness to an open door or window at such times should be avoided, especially if there be an inward breeze or puffs of air.

The cases of fatal injury to persons so situated are too numerous to be disregarded. There is even a record of a discharge entering the open windows of a railway train. The carriage was badly jolted, and one of the passengers was stunned. It seems probable that a streak of air containing rather more moisture than that around it, and hence affording a better conductor for carriage electric current, may be wafted into a house or through some large opening just at the instant of a discharge. It is, therefore, wise, even if one does not mind the possible wetting, to avoid sitting or standing where such a death-bearing puff can touch him.

One of the most mysterious things about lightning is the way in which it discriminates. It spares the mother and kills the infant in her lap. It strikes with fatal force one child and leaves its playmates unharmed. It slays a boy mounted on a horse, while his sister right behind him on the same animal escapes. The outside two of four men sitting on a bench are killed while the intervening two are unhurt. The driver of a wagon containing ten men is the only one of the party to suffer from a discharge that strikes the vehicle. Possibly the nearness to or contact with a piece of metal or other good conductor guides the current in such cases. The death of a dog while his master survives, and the slaughter of a hen and chickens while a child among them is untouched, is explicable on the theory that the current was not strong enough to hurt the larger creature, but too much for the smaller. Statisticians say that 54 oaks and 15 pine trees are struck by lightning to every beech, a greater amount of iron in the oak being suggested as a possible explanation of this curious preference. Sand and clay are believed to have a greater attraction for lightning than a chalky soil.

Narratives of a flock of ducks being hit during a flight and hundreds of birds falling dead are too Munchausenish for credence. Any object, animate or inanimate, is safe so long as it is not in contact with some more or less good conductor to the earth. Suspension in the open air virtually insulates it. Plenty of balloons have been up in the midst of a thunder storm, but it is not believed that one was ever hurt by the electric fluid. Whether lightning ever photographs any image but its own is open to question. Much of the tattooing and tree picturing recounted in the newspapers is probably nothing, but some unusual form of the marking of the body already referred to and not a copying process. The resemblance to twigs and leaves is likely to be accidental. Likenesses of persons and of objects, such as decorated china plates, are said to have been impressed upon window panes, and to have lasted for many hours, growing fainter and fainter. But it is hard to find cases of this sort authenticated in a way that commands scientific confidence.

Unusual, yet not so rare as to leave room for question as to the reality of the occurrence, is the appearance of lightning out of a clear or almost clear sky. In these cases, usually, if not always, clouds and rain prevail only a few miles away; and it is probable that the air where the phenomenon is observed is also heavily laden with vapour. The electric disturbance set up by discharges at a distance might easily affect the unseen water particles immediately overhead, where the sky is practically clear, and should the strain prove too great, a discharge must ensue here precisely as where the clouds are visible, Rain no doubt plays an important part in the question of electricity; but this process need not necessarily be conducted on the scene. If the work be done a mile or more away, the product can easily be transmitted to vapour masses away from the place of original development. It is not requisite that a volume of moisture should be so condensed as to be actually visible in order to become a reservoir of electricity.

Sometimes the electric manifestation during a thunder storm is unlike the ordinary discharge. The appearance is in the form of a ball, not a streak; and generally in such cases the phenomenon, instead of lasting only an infinitesimal fraction of a second, endures several seconds. There has been a disposition to treat all incidents of this class as optical illusions, and, unfortunately, out of hundreds of photographs of lightning obtained by professionals and amateurs, there is not one known to scientists that is accepted without question which portrays this peculiar and interesting display. But the genuineness of the phenomenon is admitted by all experts. The writer has before him 57 newspaper descriptions of such occurrences, collected within the last six or seven years. After making proper allowance for the excitement of the observer, and the exaggerations and unconscious distortion of the original story by the average reporter, there still remains a convincing mass of testimony.

Globular lightning appears in sizes all the way from a billiard ball to a 20-feet sphere. Sometimes these spheres are spoken of as "little," sometimes "large." A football or cocoanut is occasionally mentioned as a comparison of their dimensions. From the omissions of any reference to colour, it is to be inferred that usually the light is virtually white. But "a greenish tinge," "a soft yellow hue," "a rosy colour," and "iridescent like a soap bubble" are some of the phrases used in describing these appearances. Often the globe seems to roll along the ground, or the carpet of a room, or an electric wire. Again, it floats in the air. The velocity with which it moves is various. One story will say the ball was suspended, stationary, for a second or two from a wire, or it lay on the ground an instant. A display at Ringstead Bay, Dorsetshire, on August 17th, 1876, included several small globes visible at once, moving up and down slowly and independently like soap-bubbles. "Leisurely" is a term not infrequently used in this connection. Again, at times, the ball flies as if shot from a gun, or it dances and bounds on the ground. Sometimes you can walk fast enough to think you can catch it.

Now and then this spectacle is seen without any attendant noise. "A hissing sound" is one of the accompaniments sometimes reported. But explosions, like a pistol-shot or the discharge of a bomb or cannon, are more frequently mentioned as occurring when the light goes out. The Ohio State Weather Bureau had an account in 1885 of a ball of lightning that entered a window through a wire screen intended to exclude mosquitoes! It rolled along between two servants and exploded with a series of noises like a bunch of fire crackers. A second one close by on the same day fell to the ground and died out with a solitary bang. In many cases no harm is done to person or property. But again, buildings are set on fire, human beings and animals are killed, and more or less destructive pranks are played.

Several traits of lightning have been discovered by photography that were not previously suspected. So ephemeral is the flash—it seldom lasts over a two-hundredth part of a second, and some authorities say that it occasionally en-

dures only a millionth—that the eye can distinguish little beyond the general round traversed. The poetic and popular conception of the path of lightning is that it is a series of zigzags. Photography proves, however, that the track does not contain a single angle, but is sinuous like a river. It is a curious fact that in 1856, before this fact was established, Mr. James Nasmith declared to the British Association for the Advancement of Science that he had never observed the zigzag form of lightning, but that to his eye the flash always appeared as in a diagram which he exhibited, showing only curves, and with or without branches or forks. It is now evident that he was an exceptionally keen observer. Photographs reveal not only the sinuosity of the track, but also the ramified character of many flashes.

Sometimes the filaments diverging from the main line are as numerous and delicate as the rootlets of a tree, or the small tributaries to a river. Whether these branches flow into or out of the principal stream it is not easy to say, yet electricity often discharges itself by a number of routes, the quantity of fluid taking each one being in proportion to the conductivity of the air of other substances through which the current at that point passes. These photographs of ramified lightning render much more intelligible than was formerly the case some of the stories of thunderbolt freaks. Unquestionably, instead of one solitary current skipping to and fro around a room or among several buildings, as has been supposed, was the case in certain instances, the stream has divided into several, each taking a tolerably direct course to the earth. Besides the sinuous and ramified types, photography shows the existence of many other forms.

A variety of causes have been assigned for the development of atmospheric electricity, evaporations, combustions, decay, friction of dust particles, and so on. Whatever differences of opinion exist on this point, though it is generally agreed that a tremendous concentration of the fluid, or force, occurs with the condensations of vapour in a storm-cloud. While yet the water retains the form of mist, the surface of millions of minute globules affords a residence for the electricity there present. But when, through contact with an icy atmospheric layer the moisture of the cloud is compacted into solid raindrops, the surface area is greatly diminished, and the capacity for holding the charge is correspondingly reduced. This heightens the "potential" or strain, and forces a discharge.

WIPING OUT WORMS.

Earthworms are often the ruin of plants that are otherwise quite healthy. Many pots plants are ruined from this cause. The worms take the soil down amongst the drainage, stagnation follows, and the foliage becomes yellow and soon falls off. Experienced growers are most careful to exclude worms, or, if they gain admittance to the pots, which they are apt to do when the bottom of the pot rests on soil containing worms, they expel them as soon as possible. If there are worms in the pot, and the latter is struck sharply with the knuckles or a piece of wood, the worms will quickly make their appearance on the surface, when they may be removed. Lime-water will also make the soil distasteful to them; but as this cannot be applied to all plants without injury, soot-water is the best to use, as it is a stimulant, and should be given to all pot plants whenever worms are suspected to exist. In using soil for potting, great care should always be taken to remove the worms from it before putting it in the pot.

IS THERE A SENSE OF DIRECTION?

Although it seems to me beyond dispute that among the lower animals there is an instinct which teaches them to find their way to a given point regardless of darkness or of previous knowledge of the locality, it is not generally believed that man possesses a similar sense, if we may so term it. A man's ability to find his way to a given point is dependent solely upon a habit of observation, almost unconscious, to be sure, in many cases, but necessary to the end in view. We shall not discuss the truth or falsity of the ingenious theory advanced a few years ago, that the pineal gland in the brain is the seat of such a sense in animals, and that they find their way by means of some perception by this portion of the brain of the direction of terrestrial electric currents. All reasonable men are satisfied that animals have this ability to find their way.

Thus, most of us are familiar with instances in which a cat, for example, has been taken in a box or satchel for ten, twenty, or even fifty miles from home, and has returned in such an incredibly short time that we may be certain she has travelled by the most direct route. Carrier pigeons transported in closed cars or in ships have no difficulty in determining their direction of flight, even when liberated out of sight of land. The cowboys of the "Wild West" make it a rule to pick for night herding well-broken horses that are known to be anxious to reach camp when given the reins. Such ponies, even if obliged to follow the herd away from camp for several miles, will find their way back in safety in spite of the darkness. This selection of certain horses for night-work does not in the least vitiate our conclusion. They are not chosen for their power of finding their way back, but for their known inclination to do so. Even these horses sometimes fail, as, for instance, in the face of a severe storm, for they drift with the wind at such times rather than face it.

As we cannot conceive that a horse or pigeon should guide himself by the position of the sun or of the north star, even if we eliminate from the problem the well-known fact that darkness seems to make no difference in the exercise of this homing instinct, we may take it for granted that animals and birds have this sense of direction, for examples similar to those given above might be given by the score. It might be supposed that this instinct had formerly existed in man, but had been lost during his progress toward his present state of civilisation. Writers speak of the "unerring instinct" which guides the savage through the vast stretches of pathless forest in which he resides. But we are also told of the accuracy of observation of the individuals of this same race. The Indian, for instance, is familiar with the path of the sun and the position of the heavenly bodies. He observes everything within his horizon, the mountain ranges, prominent peaks, and passes; he notes every stream, its size, character, and general course; he sees all the prominent objects along his trail.

If the sun is obscured, and he is temporarily lost, he accomplishes his orientation by observing the rougher bark on the north side of some varieties of forest trees; or he finds the wild morning glory facing eastward at daybreak, for the faithful Moslem is not more certain to look towards the rising sun. He no doubt observes, also, that the warping action of the sun's ray detaches the bark sooner from the south side of the standing dead timber than from the other sides. These and a hundred similar signs are to be read by the student of nature. Only after years of experience, if at all, does the white man acquire these wonderful powers of

observation. We are told by travellers that it is much the same with other primitive races, the necessary qualities being intensified by inheritance through long generations of nomadic ancestors. But as we have advanced in civilisation, and sign-posts have taken the place of the signs which the Indian reads, we have retrograded in these matters until the civilised man, despite his knowledge, is lost more easily than his barbaric ancestors, unless he takes especial precautions to note those things which they observed without effort.

It seems that our proposition, viz., that we keep our direction by observation, conscious or unconscious, of surrounding objects, will be established if we are able to prove these three things :—

First, that those lacking in the power of observation are most easily lost.

Second, that those in whom this faculty is well developed are rarely lost.

Third, that the latter are easily lost when they lose sight of all external objects, as in fog or darkness, or when their attention is concentrated upon something else to such an extent that they do not observe their surroundings.

We trust that our term "power of observation" is plain to all. In this connection we mean that faculty which enables one to note surrounding objects, and to bear in mind their relations to each other and to himself. The power which enables one to look at a landscape and say that it is familiar is the same as that which permits some of us to look at a word and determine whether or not it is spelled correctly; for notoriously poor spellers are such, not from poor memories necessarily, but from lack of the faculty in question.

Next to observers poor by nature, we might place those who lack experience, as those who have always dwelt in cities. Of course the great majority of these acquire proficiency by practice. Short-sighted persons who do not correct their myopia by the use of glasses come under the same head, for, being unable to observe their surroundings, they are very prone to become lost. Fortunately this disease is comparatively rare in primitive races, natural selection, no doubt, contributing to render it so, for it is vastly more common in civilisation.

Among the female inhabitants of towns and cities the faculty in question has had no opportunity for development for many generations, perhaps. They ordinarily have a very poor "sense of direction." We have yet to see a woman from civilised life who could be trusted to point out the way across a pathless region of any considerable extent.

Second, good observers do not readily lose their way. Hunters to be even moderately successful, must be the closest of observers. The appearance of a man or an animal anywhere within the circle of vision is ordinarily noted at once. The habit of seeing what lies before one, a thing not given to us all, is formed. With men who travel much alone, the exercise of this faculty fills the gap left by the lack of opportunity for conversation. It gives the mind a certain amount of exercise. The Mexican sheep-herder who is alone on his range will tell you, a week after, who has passed by, what kind of a horse he rode, whether a colt followed a certain wagon the trail of which he has seen, and other details that surprise one not accustomed to such matters. The cowboy who rides a hundred miles across country will tell you the brand of every stray steer he has seen. These men realising that they are dependent upon their own exertions for safety, unconsciously develop those faculties of service to them. Other men, placed in similar positions, develop in the same manner, as trappers, explorers, and scouts. Think, for instance, what chance there would be of a trapper's getting lost when he is able to place fifty traps in a new region and find them all without effort. Here his memory is, of course, of as much importance to him as his close attention to his surroundings.

Our third proposition is, that even those who are ordinarily entirely competent to find their way get lost easily in darkness, or fog, snowstorms, and especially if interested in something which thoroughly occupies the mind. This we believe to be utterly inconsistent with the theory of a proper "sense of direction." We have an authenticated story before us of a hunter who after vainly striving to find his way which lay due east in a snowstorm, by means of his unaided instincts, was compelled to have recourse to his compass. He tells us that, "at first sight I was tempted to believe that the needle was wrong, as I am told all men in similar positions are. I carried the compass to some distance from my rifle, fearing that the needle was deflected by the metallic barrel. The result was the same. Fearing that I had found a body of iron ore by accident, I tried various localities, but the needle still persisted in pointing, as it seemed to me, south. After a few moments' consideration I started over a ridge a little to the right of the way I had come, and due east by compass. I still felt that I was going west, and could not get over the idea. A tramp of half an hour brought me within sight of the valley I sought, and north seemed to come around where it should have been all the time. I had unconsciously crossed the Continental Divine (Wyoming, U.S.A.) at its lowest point, far lower than the one at which I now crossed, evidently having made an entire turn when starting homeward instead of a half one as I had intended. I now made a bee-line for camp, but I carried home with me less faith in my 'sense of direction' than I had upon starting out."

It is sufficient to say, in conclusion, that, whatever instincts man may have had in a former state, he has at present no means of finding his way at all resembling that possessed by birds and animals.

CLOUDS OF INFECTION.

Mr. Appleby King, of Margate, has been giving some very interesting demonstrations before various scientific societies on Bacterial Clouds. From investigations made with the microscope, Mr. King has found that there are currents of air which blow bacterial clouds in various directions, and that rays taken at high altitudes contain none of the bacterial germs found nearer the earth. This has its special bearing on certain features of immunity in epidemic disease. For instance, of two persons who may be apparently subjected to the same zymotic influence, one may escape the infection and the other have it. One has walked through a bacterial cloud and has breathed in the infection, while the other has fortunately avoided it.

On the 28th May, 1860, Pasteur opened, on an uncovered terrace, a few metres above the ground, four flasks containing water of yeast. Nothing appeared in them until the 5th of June, when a small tuft of mycelium was observed in one of them. On the 6th a second tuft appeared in another flask; the two remaining flasks continuing intact and without organisms. It was from these observations that Pasteur inferred the non-continuity of the cause to which so-called spontaneous generation is due. Observations made in this way showed that in the midst of a bacterial cloud, life was obtained, and sometimes in the interspace between two clouds no life could be found.

MUSIC AMONG ANIMALS.

A few words on musical animals will not be inappropriate, because music is the half way house to articulation. It is the first great reduction to order of the sounds made by the vibrating chords and resonant tubercles of the throat and jaws; and that must have occurred before any such speech as man possesses. The lowest creatures are silent creatures. They have no way of communicating by sound, but by touch only. The first ear is far down among the jelly fishes, and consists of fine grains of lime, moving to and fro, and having a nerve attachment. This implies a power to hear sounds, but not to distinguish rhythm and analyse sounds with any degree of nicety. As we move upward in evolution we see the organ of hearing developed into higher and higher capacity; so also the organ of expressing sound. Music may be said to exist when to us it is not so apparent. The croaking frogs of spring are not dissonant. In midsummer the most wonderful fact is that the millions of crickets, cicadas, and the toads utter cadences. The vast volume of sounds that fill the night air move in beats of harmony. Exceeding care in listening will enable you to distinguish at least three separate keys on which the air is struck.

It will be very difficult for us to find any creature not susceptible to harmony of sound, and few will be discovered incapable of some degree of music. Their fondness for music is in many cases equalled by their dread of harsh discords. This is not only true of birds, but of the higher-bred dogs, cows, and horses. A Jersey cow has not a voice like a canary, but she has a fine modulation, and never bellows like coarser bred cattle. It is easy to know what they want by their tones. An unruly cow will stand to be milked more readily by one who will sing or whistle. A farmer tells us that he used to sing to his cows, and "they knew when we changed from one tune to another. When we sang sober church tunes they lopped their ears, and reminded us of the people in the pews, who chew cloves and try to look pious, but really are quite sleepy. Then striking into something lively we could see a quick response from ears to tail. And when we stopped every cow would turn her head, as if asking us to go on."

We are told of an officer who had a bad ear for music; and had never been able to master a single tune in his life; and what was worse, had no idea of time. It was essential, however, that commands given by the bugle should be delivered by word of mouth to the men. This placed the officer in a dilemma. A friend advised him to change his own horse for Mazeppa, who belonged to one of his sergeants. She would carry him through. He did so, watching every movement of his animal during the evolutions. When the bugle sounded forward, the knowing animal advanced; and the command was accordingly given to the men. When the call for halt came, Mazeppa stood like a rock, and the proper order was issued by the officer. In this way the horse by his ear for music told its rider the orders of the day, and carried him safely through the complicated movements of the drill.

We have seen a dog that was a very respectable dancer to tunes whistled by his master or played on the piano. He would balance himself on his hind legs and pick out the steps with nice precision, and seemed to be capable of being taught much more in the same line. A young lady has a Scotch terrier which she claims is a musician. He, at least, has an ear to discriminate notes, and is a good critic. It was when he was but a pup of three months that, hearing a hand organ play the "Boulanger March," he began to caper in a pleased manner, and keep time with playful yelps. When the tune changed to "The heart bowed down," Bernardo fell to the floor, and moaned as if in pain. This led to tests of the dog's ability. The young lady played the "Swan Song" from "Lohengrin," on the piano, which had the effect of making Bernardo walk slowly around, plaintively barking all the while. She then played half a dozen other selections, such as "The soldier's song," from "Faust," the "Star spangled banner," the "Marseillaise Hymn," "Yankee Doodle." Lively music made the dog run in a frolicsome way, emitting short barks. "Yankee Doodle" set him into prolonged barks, and the "Marseillaise" drove him into a corner howling with fear. The dog is now much older, and has developed an extraordinary fondness for the piano, insisting on always being beside his mistress when she plays.

A more remarkable illustration of musical taste in dogs comes from a medical man. He owns a handsome black and tan terrier who accompanies his master in a duet. "The last rose of summer" is her special favourite. At a signal Jennie mounts a piano stool, and with head erect surveys the auditors. "As the doctor gave a prelude on his violin she opened her mouth in the present style of vocalisation, and started in with a sort of whine. As the doctor proceeded with 'The last rose of summer' the songstress showed, by increasing pathos, the force of the musical afflatus, and of the sentiment. The performance was certainly most wonderful." She refuses positively to perform if anyone laughs. Another terrier, owned by a dog fancier, is on his feet the moment his master whistles a waltz. He keeps perfect time, and does not stop till the music ceases. A newspaper some time ago reported the case of a dog that at least persistently tries to sing. "Although he cannot pronounce fa-sol-la-mi-do, he succeeds in a good imitation of the sounds, and can cause his voice to rise and fall with the notes." At first he would only accompany a young lady of the family, but he has gradually overcome his bashfulness and allows others to be present.

These are perhaps extreme cases, and are given to show that the power of expression and of perception is dormant in all creatures. The wild dog only howls and snarls; the civilised dog barks. We do not yet know how far the bark may be developed in intonation toward articulation. A magazine some time ago gave a well authenticated report equally interesting of the musical taste of mice. A gentleman in Florida heard at night what at first he supposed to be the chirping of birds in the chimney. The mystery was cleared up in an unexpected way. A very small mouse came up from a crevice in the hearth, and with singular boldness took position in the middle of the sitting room floor. Here she sat on her hind feet and looked about with the utmost confidence, all the time singing in a low, soft, yet really warbling style. This visit became a daily business, until she paid the penalty of her temerity by being captured. About a month after this prodigy was intrusted to the writer of the report. It turned out to be one of the wood mice, not so large as our house mouse. "For a considerable time she carolled almost incessantly, only when she slept. To be sure it was a low, very low, sweet voice; but there was, with a singular weirdness, something so sweetly merry that I would listen on and on until I would fall asleep in the lullaby of my wingless and quadrupedal bobolink." This little musician, which went by the name of Hespie, had two roles; one the writer calls her wheel song, and the other the grand role. We quote one more passage. "She had just

woke from a long sleep, and had eaten some favourite food, when she burst into a fulness of song, very rich in its variety. While running and jumping she carolled off what I have called her grand role; then sitting she went over it again, ringing out the strangest diversity of changes, by an almost whimsical transposition of the bars of the melody; then, without for even an instant stopping the music, she leaped into the wheel, sent it revolving at its highest speed, and while thus running in the wheel she went through her wheel song in exquisite style. After this, without arresting at all the singing, she returned to the large compartment, sat upright, resumed the grand role and put into it variations that astonished me."

This dainty story is well matched by others concerning mice. A well-known writer says; "Some years ago an associate editor of mine told me that two of these little musicians came into his office every night about twelve o'clock when all was still to eat crumbs and afterwards sing. I sat with him one night to hear the performance. The housekeeper left coffee and sandwiches at a quarter before midnight. Presently I saw a mouse coming nimbly for the crumbs. Seeing two persons he turned back, but was met by another. After having satisfied their hunger they began gambolling about. Then one of them suddenly burst out into a dainty ditty. He ran up and down a perfect scale of musical notes; and then gathered several together in a burst of music. The note was silvery, thin, and sweet, and to my ear almost exactly like that of a finish before a shower." The two joined their voices and kept up the concert for half an hour.

A collector of insects and reptiles reports his efforts a training his pets to distinguish tunes and discords. The ears of all creatures are far more apt than we commonly suppose at detecting slight variations of sound. He concludes that almost all vertebrate animals are susceptible to music in a greater or less degree. The snake charmers of India also make reptiles quiet and easily handled by subjecting them to music. Sound has both an exciting and soothing influence on the nerves. When hypnotism is better understood we shall find that the cataleptic sleep can be produced through the ear as well as through the eye.

Our natural association of song is only with feathered bipeds of the air. And here their incapacity to comprehend and compass articulation is well matched by our incapacity for comprehending the power and breadth of the vocalisation. That it includes a very complete language no one can doubt after a prolonged study of their music.

We do not believe any of our birds will sing precisely the same song a thousand years from now; but out of their present languages will arise many probably much more complex and articulate. The thrush family may be designated as peculiarly oratorical, and the robin song is not so stereotyped as to be incapable of marked differences of modulation. As generally heard it is crude, unfinished, careless; but in that lies its possible inflections.

It is insisted by many naturalists that even fishes have a genuine music—love calls or nuptial hymns. Even "in our common eel we have an instance of a fish possessing unmistakable evidences of voice. In the matter of voice eels utter a more distinctly musical sound than any other fish. It is a single note, frequently repeated, and has a slight metallic resonance. An angler tells us he has heard this sound only at night, and never when they are taken from the water by day." As, however, the sounds uttered by fishes generally excel in frequency at the breeding season, it will be reasonable to consider them as nuptial hymns. It will not be difficult for us, after a careful consideration of the universality of musical utterances already discovered, to believe that, although undetected by us, there is to every living creature, at least above the invertebrates, a power of vocalisation that amounts to what may fairly be held to be music.

SHAMMING DEATH.

It is well known in India that remarkable cases of suspended animation have occurred, the fakirs or religious mendicants sometimes allowing themselves to be buried for certain specified times in order to prove the reality of their claims. Several instances of this kind have been verified by credible witnesses, but one such case was placed beyond all possible doubt by the presence of a number of witnesses of prominence. In 1837 Sir Claude Wade, then British Resident at the court of Loodhiana, witnessed the performance, by a fakir, of this feat.

The man was put into a linen bag, the bag was put into a large locked box, which was deposited in a cell in the middle of a brick vault, every opening to which was walled up and sealed. As a supreme precaution, a guard was set, four soldiers patrolling the sides of the vault day and night. At the end of six weeks the vault was opened, the body taken out, and the most careful examination by skilled English surgeons failed to detect any sign of pulse or respiration. The apparently dead body was bathed and massaged by the attendants of the fakir, and in half an hour he was completely restored and conversed with those about him, though in a feeble voice as of one long ill. The facts were widely published at the time, and the perfect reliability of the parties relating them caused great interest in the story.

THE DANGER OF CHEESE.

A singular fact with regard to an unsuspected property o cheese which has been accidentally discovered is interesting to chemists, aside from its hygienic bearings. It appears that nickel-plated ware, which is deservedly in favour with housekeepers on account of its durability, its handsome appearance and the ease with which it is cleaned, is attacked more energetically by cheese than even by vinegar or lactic acid. All kinds of cheese are found to produce this effect in the same degree; even when dry any of them will eat into a nickel-plated salver in less than twelve hours. Since ordinary cheese shows a decided neutral reaction when treated with litmus paper, it was supposed that the trifling amount of baldrianic *(sic)* acid which it contains would be insufficient to account for the phenomenon. This assumption, however, turns out to be erroneous, for as the result of direct experiment it is found that nickel is speedily corroded by baldrianic *(sic)* acid. We have quoted this article from a contemporary, whose name we cannot discover.

Our Monthly Edition.

Science Siftings may now be obtained in Monthly Parts, bound in buff wrappers. Price 6d., or post free, 8d., of any Newsagent; W. H. Smith & Son's bookstalls; or of the Publisher, 78, Fleet-street, E.C.

If you have an idea for a patent, write to the Editor of Science Siftings, giving the outline of your scheme. The communications will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

SOCIAL SCIENCE.

A SOCIAL SIN.

Hurry is a crime against health and life quite equivalent to taking poison or doing ourselves other violence—in fact, it is a social sin. We remember the advice of an old coachman who had exceptionally fine horses: "Don't hurry at the beginning. Let your horses start easy, warm up to work and go ahead naturally. You will get over the ground more quickly by that means." But if you will watch most drivers they are in a fume at the outset. They get their horses into a fret, and fag them out before they have done any really good travelling. Children generally set us a good example. They shout and prance a little to begin with, but are in prime condition to play after hours of lively games. A well-driven horse can work or travel all day. Hurried for half a mile a fine horse gives out.

The secret of dyspepsia in over half the cases is known to be eating too rapidly. The stoutest men cannot endure it. Furthermore they cannot endure dyspepsia. Indigestion means simply that the blood in the stomach fails to do its duty—so also the organs that perform their function in the way of working and assimilating food. One-third the food usually eaten, if well and leisurely chewed, would nourish the system more than what is now hastily swallowed. A man of unusally fine build, a carpenter, said to us: "I am in constant misery. My food hurts me." "How much time do you spend at the table?" "Oh, not much." I am not a gormandiser. I don't sit ten minutes at the table. I am in a hurry; swallow a little coffee and meat, and a piece of pie, and am back at work." The man did not know that eating was business. He did not understand that he had anything to do with digesting and assimilating his food.

The spectre that haunts us is that we have not time enough. What we wish to urge is that you will be able to do more work, and better work, if you will undertake it leisurely, and without a nervous scramble to get quickly through. We really have time enough to get all our work—all necessary work—well accomplished. By this we do not intend to befriend putting off what one has to do with excellent reason. There is a rational coolness and calmness that covers the demands of life more admirably than the most inveterate haste. Time enough, we assure you. You will not get on any faster by rushing. Order and system are everything; but hurry is inevitably mischievous.

We have studied children with considerable care, and have noticed that those who are allowed to form bad habits of hurrying grow old and mature quickly. The lines of care form at a very early age down by their eyes and around their mouths. It is criminal to say to a child "Now, hurry up with that work," and so keep up a nagging and driving. Work in that way loses all its natural pleasure and frets the doer into nervous anxiety. We believe it is possible to teach our children to be industrious and faithful, so that they will do a great deal of good work, but never be fagged or fretted by it. It is quite true that we must set them to do at times what they do not prefer, but this can be made reasonably pleasant if we use wisdom. Children's studies, like their work, need never be tasks. We cannot express strongly enough our indignation that the small children of this land should be cooped up twice a day—children between 4 and 8—and compelled to use books. It is unnatural and an outrage to their bodies and minds. These growing creatures should be almost anywhere else.

Our factory laws forbidding the employment of children should be changed to laws forbidding the schooling of children at a premature age. The mental development cannot be wisely hurried. A task for the brain is worse than a task for the hands. Do not be in a hurry about education. Nothing is lost by a few years of freedom. The education of children should not be forced like the growth of plants in a hot-house. The more haste in this matter the less speed in the end. It is from too early forcing of the intellect, from premature, precocious, mental growth that we see in modern times so many cases of feeble and sickly children; or of remarkable wonderful children who grow up to be prodigies by their third year, and die the next.

We do not misapprehend the difficulty of this problem of hurry, for it meets us at every corner. We are tempted to whip up constantly. But the conviction has become so strong that we inevitably lose by it that we seldom give way. The least strain of an organ is a financial loss; it is also a loss of intellectual power. It is astonishing what ease of memory accompanies entirely wholesome work. A boy whose education goes on naturally is unable to forget. But we are obliged to say to ourselves very frequently: "You have done enough. The blood begins to ring a little in your ears." Ah, but how much one could accomplish just now under high pressure! To be sure; but the reaction might last a week. You would count yourself fortunate if you did not suffer permanent damage.

There are doubtless hundreds who say, "Ah, well; that will "do for a man of leisure—a man who has capital; but how "about one who can only get enough to keep himself and "family fed and clothed?" Even then there is no advantage in whipping up nature. The whole business of using stimulants—even mild ones—is a mistake. We are not talking about intoxicants. Move steadily, not quickly, and firmly, and in the end your income will be larger than by any system of hard-scramble and hurry. Even the poorest would be benefited by learning to appreciate relaxation. In this country there are few who are compelled to adopt the furious drive which, after all, characterises our workmen.

There are two styles of work and workmen. One man never tackles a job but he wishes immediately to see the end of it. His idea is accomplishment. He finds no pleasure in doing, but in getting done. He thinks only of how fast he can make his fingers fly, or his feet to reach the goal. But the other man is of this sort: he finds pleasure in the doing; every step of the process is to him interesting. He enjoys himself, by the way, and does not care to get to the end. This man is the real philosopher.

The value of a holiday is to slow up our work. Sunday is a human, a most human day; and no interpretation of it was ever wiser than that it was "made for man," and not man for it. The whole secret of its value is to check us in work. It is really a marvellous thing that all classes should for one day in seven lay aside money-getting. It seems most strange that the very poor who could not and would not spare one-seventh of their income otherwise, are quite willing to let go that much in the way of a holiday. Sabbatarianism is quite another thing, and very often abolishes rest altogether.

Let it be understood that the object of the Sabbath is moral, physical, and intellectual recuperation, and we shall have no more struggle over opening expositions and museums on Sunday. The problem will be solved purely as a question of relief from overwear and wearing out. The whole moral force of the nation should be combined to prevent the deterio-

ration of our stock. It is a national problem, whereas the Sunday issue, as often presented, is a mere wrangle of opinion, an effort to force others to see and do as we choose to see and do ourselves. There is no mistaking the drift towards more holidays. But the matter of most importance is that we shall not over-drive when we are at work. Even a holiday may be a day of exhaustion. No people can thrive on dogged work alone. It must also have the fine art of recuperative rest. The long-lived races have all been lovers of labour, but also lovers of needful rest.

Put your finger on your pulse, and make sure you do not compel that delicate machine, the heart, to make such strokes as will inevitably pull down the whole mechanism. Yet we all despise loiterers and delayers, and those who cannot accomplish a good life work. We would not write a word in defence of insignificance. The time has come for individuals; every man must count one; every woman must be known for what she is worth. The masses are abolished. To do fairly and squarely a good wholesome, well-rounded day's work, lies before us as the ideal. How much can you do, do it well, and remain yourself well? This is the justest problem that you can work out. To crowd on steam after that, is to detract from the power of your mechanism for the sake of a small immediate success. We desire to discourage the tendency to be proud of mere speed.

HELPFUL HINTS.

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

A New Enthusiasm.

W. Folkes Mills.—Your remarks with reference to our article under the above heading are of much interest. Your suggestion that "a chance to honestly progress" would be given to many a worthy but unfortunate trader if some philanthropic association could be induced to buoy him up by loans or guarantees of money in times of pressure, certainly commends itself to us. Reliance on "man's honesty" in particular cases could scarcely be called a *new* enthusiasm, but may, no doubt, work well. The weak point in your scheme appears to us to consist in the fact that the maximum of honesty may sometimes be accompanied by the minimum of technical skill or business ability and judgment. It is, of course, desirable, as a matter of public policy, that the working capital of the manufacturing and trading community should be concentrated to a sufficient extent in the hands of those who are able to employ it most successfully. And from this point of view we do not think that it would be true economy to loan capital even to superlatively honest tradesmen who had brought themselves into difficulties, as you describe, by errors of judgment. Thanks for your observations re title. The name *Search Light* is already appropriated by a flourishing and excellent threepenny monthly periodical, published at Temple-chambers, E.C.

To Make a Dry Battery.

Chas. A. Clark.—Take a number, say two dozen, of copper coins and brighten their flat surfaces with emery paper. Solder to one side of each coin a thin disc of equal size of sheet zinc. Put the discs, with their similar faces all pointing in one direction. in a cylindrical wooden or cardboard case. And while placing them in position, insert carefully between each a disc of blotting paper or preferably, asbestos paper, moistened with a solution of salt in water containing a little chloride of calcium. Apply a moderate pressure to the extremities of the pile and attach one of your conducting wires to each of the terminal discs.

Technical Education.

R. Rigby.—One of the best certificates proficiency of in applied mechanics is the Whitworth Scholarship open to any young man, under 26 years of age, who has been engaged for not less than 3 years in handicraft in a mechanical engineering works. We cannot give a general answer to all of your questions. There are many technical schools offering exhibitions or scholarships for proficiency in the various subjects named; but as a rule only to matriculated students.

Bleaching Bones or Ivory.

H. Pybus.—To bleach bones of birds, etc., for mounting, wash well in strong soda solution to remove grease. Next treat with a solution of chloride of lime (bleaching powder), rinse in water, and dry in the sun.

Hot Water Pans.

T. L. Brown.—There are many cheap and readily obtainable substances, which, when dissolved in water, raise its boiling temperature considerably above 100° C. Even common salt may be used with advantage for your purpose. Chloride of calcium would be better. Fill the warming pan with a saturated solution of (say) common salt, and raise it to just upon the temperature of ebullition. The pan will then retain its heat for a long time. But why not use an oil stove, which would be very much less troublesome.

Miscellaneous.

A Finished Dragoon.—Thanks for your comments. The paragraph referred to was translated and abridged from a Finnish vernacular paper, but hind should have read iron, in one case. The last sentence should not be too literally interpreted. The durability of the horse shoes is probably explained by the fact that they are made heavier in Finland than elsewhere.

G. Lewis.—The surprising celestial phenomena which you observed were well worth noting. But we can only regret not having space at our disposal for recording such observations.

H. Summons.—Powdered permanganate of potash is soluble in water without the addition of any other chemicals. We are gratified by your very favourable comments, and can promise you that the same activity will be manifested in the future in discovering and exposing such fraudulent pretences.

K. W. Y.—Thanks for your communication. We are interested in the pamphlet sent. Will endeavour to look the matter up as you suggest.

Jno. Wm. Frank.—Thanks for your very favourable comments. We will endeavour to merit the support you so kindly promise.

A Constant Reader.—We are much obliged by your friendly letter and suggestion, but cannot see our way, just at present, to make room for the additional matter. We will be pleased, however, to accede as far as possible to any special requests for information on the subjects you refer to. Mercury and Venus are morning, and Mars and Jupiter are evening stars during this month.

J. M.—We should be most happy to assist you but cannot undertake the responsibility of advising treatment for weakness of the heart's action. There is no specific that we know of. Each case must be dealt with according to its special peculiarities, and, therefore, the advice of a qualified physician should be sought. We shall be glad to send you the name of one who has been very successful with such cases, on receipt of stamped envelope.

F. Barker Cooke.—We do not know any *mineral* of the name of "litho-carbon." It is probably some patented compound or merely a trade mark.

Henry A. Hopkins.—Thanks for your letter, which proves that you have carefully read our articles on "Social Science." Your remarks cover so much ground that it would, however, be impossible to reply to them in detail in this column. Nor should he care to enter into a *discussion* of so very controversial a subject as political economics. Of this you may be assured that the writer of the articles is a distinguished authority on that science.

Snap.—We regret that, as you surmise, several other competitors had forestalled you in sending in the query.

Frank H. Wood.—The specimens you sent, and which probably you supposed to be meteoric, have been examined by a microscopist who pronounces them to be of terrestrial origin. The source may very likely have been an accumulation of dust in a crevice in a tree or other elevated position.

E. L. Garbett.—We cannot give you Mons. Nouri's address just at present. We believe he is travelling. Should we decide to inaugurate a pilgrimage to the Arc next summer, it will no doubt be very largely attended.

Subscriber.—Thanks for suggestion re title. Your previous letter was replied to in a previous issue.

Ralph Rigby.—Yes. True diamonds have been made artificially, but only of extremely small size.

Wm. Lister.—Electricity is *supposed* to be produced in the electropathic belts by a galvanic combination, resembling to some extent that described under "Dry Battery" above. In some cases a very minute electric current is generated. In others none at all.

M. D. Edin.—We have some further important disclosures to make about electric-belt quacks, but we shall not publish them until they are fully verified.

Charles H. Ward.—The paragraph appeared in the *Daily News* on Sept. 1.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6s. 6d. *6 months,* 3s. 4d., *3 months,* 1s. 9d.

Advertisement Offices: 167, & 168, Fleet Street, E.C.

'Sale and Exchange' Advertisement Offices: 78, Fleet-street, E.C

Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, OCTOBER 1, 1892.

HARNESS'S BELTS.

WE HAVE RELUCTANTLY DECIDED TO ABSTAIN AT PRESENT FROM ANY FURTHER COMMENTS ON THESE APPLIANCES.

NOTICE.

On and after Oct. 22nd, commencing with No. 53, Vol. III., the Title of this Paper will be changed to:

SIFTINGS.

The Tit-Bits of Current Thought

on

Health, Science, Food, Invention, Literature, and Sociology.

SCIENCE NEWS AND NOTES.

"The reward of a thing well done is to have done it."—SENECA.

The Marvellous Cures

claimed for belt appliances that are incapable of generating electricity or incapable of sending a sufficient current through the body to effect either good or evil—for evil often does result from misapplied electricity—are not so very wonderful after all. Have our readers never heard of the faith cure or cure by suggestion, or psycho-therapeutics? Well, such things are possible and rational. That is, people can be cured of even serious ailments, by no other means than the firm belief that they are going to be cured! We would advise those who have not already read them to turn up the paragraphs that appeared in SCIENCE SIFTINGS a few weeks ago on the subject of the "Influence of Mind over Matter." We know of the authenticated instance of a medical man who had occasion to give a patient a sleeping draught. Happening to call on the chemist to whom the prescription had been sent a short time after, he was informed that through an error only distilled water had been dispensed. The doctor returned, and found that the patient had fallen into a sound sleep immediately after taking the dose. Faith and water had acted exactly in the same way as a soporific. Faith and a few strips of satin spangled with discs of metal will doubtless cure any disease. But why pay guineas for this belt cure, when the services of a "faith healer" can be obtained for 2s. 6d.?

Faith and Hope Will Cure Most Ills

to which flesh is heir. We do not advance this theory at our own instance, but we have the support of nearly the whole medical profession, notably of Dr. Dale, who we quoted in a recent issue, and also of Dr. George Robertson, senior assistant physician to the Royal Asylum at Morningside, Edinburgh. It is notorious that many sufferers have been cured by eminent physicians with the same means that have failed when advised by the family practitioner. Faith and hope again. As Dr. Robertson points out, it can only be done through a psychical agency. The patient must have greater confidence in the powers of the consultant and in his ability to cure him than in the ordinary practioner, and a greater if not complete expectation of being cured. These feelings are no doubt enhanced by the impressive manner of the consultant, by his crowd of patients from far and near, and by his big fee. The last item has a distinct psychical significance, for we automatically associate a value to an article in accordance with the cost or difficulty of obtaining it, and this has been true since the days of Naaman the Syrian.

This Frame of Mind

has been made use of in a scientific manner by Prof. Bernheim, of Nancy. He has acquired a reputation for the cure of diseases that is almost unbounded among those who have faith in his "treatment by suggestion"—for he disclaims any connection with hypnotism. The professor merely suggests to the patient in a wide-awake condition that he has no pain, and away goes the pain at once. He tells them they cannot raise their arms, and forthwith they are unable to do so—and so on. Dr. Bramwell, of Goole, practises the same kind of thing. He demonstrated four patients to the Congress of Experimental Psychology in London, and whatever he said to these patients in the wide-awake condition was instantly believed and took place. He produced anæsthesia, total and partial, hallucinations and sleep, all in a moment, by giving a verbal or written order. In one of the women he had caused to be extracted painlessly seven teeth out of eight by the simple assertion that she would suffer no pain, and he had also by this means stopped sea-sickness. His power for the benefit and comfort of these patients in the minor and more common ailments of life by simple assertion was almost complete.

Patients are Often Sent to Sleep,

however, by Professor Bernheim, because the symptoms of sleep are easy to call up, they are familiar and natural, and therefore a patient, without possessing very great confidence in the operator's powers, can with much facility, be made to believe that sleep has come upon him. Whenever the patient has been put into this state, his confidence in the operator is

immediately strengthened, as he has received a demonstration of his powers, and the subsequent suggestions of the removal of pain, etc., are so much the more easily believed in. In addition to this, in the somnolent state there exists increased suggestibility or *credivity* and less independence of thought, which assists greatly in the giving of suggestions. His *modus operandi* is to tell his patients that if they will follow his directions he will remove their ailments. He asks them to prepare to go to sleep, and in a persuasive yet confident tone he suggests the symptoms of sleep. In a few minutes the majority of patients get into a somnolent state, not so deep as ordinary sleep, in which they answer questions, but appear to have less will power and independence than in the waking state. When in this state Professor Bernheim asserts, with some persistence if need be, that the pain or other affection has gone, and almost invariably the patient accepts his suggestions and awakes free from all symptoms. We think we have now said enough to convince our readers that where cures are claimed by these "miracles of magnetism," *yclept* electric belts, the cure is solely due to a law of nature—the influence of mind over matter.

The Infusion of Blood

from a healthy to an infirm subject is a very old practice in medicine, but the injection of brain substance—although a somewhat similar operation in principle—is, as far as we know, quite new. Dr. Constantine Paul, of Paris, is the discoverer of this curative agent, which is injected into the subcutaneous cellular tissue in a liquid form. The first effect noticed by the patient is a sensation of increased strength and comfort, the previous muscular weakness diminishing rapidly. Pains and weakness disappear after a few injections. Headaches and insomnia vanish, the appetite returns, and the dyspeptic patient assimilates his food so well that his weight immediately increases. The liquid used is a ten per cent. solution of the grey substance of the brain of the sheep, sterilised by carbonic acid in Arsonval's apparatus; the injections are made into the lumbar or gluteal region, the dose being five cubic centimetres (80 minims) at most.

A Sufferer from Nervous Debility

is compared by Dr. Constantine Paul to an accumulator which it is impossible to charge. While the morbid condition lasts, he is unable to transform his food into force; after the least effort his muscular and intellectual forces are exhausted. But, it is maintained, the injection of cerebral matter in the manner described promotes the utilisation of food and its due assimilation; so that the nervous system now becomes a chargeable condenser by means of which the subject acquires force which he can dispose of at will. It should be noted that it is the nervous force which first returns in all these cases; subsequent to and consequent upon this the power to do intellectual and muscular labour comes back, the improvement in the condition of the blood following later on. The Doctor claims, in short, that the subcutaneous injection of the brain substance alleviates and cures nervous debility much more rapidly than the ordinary therapeutic measures, iron, arsenic, phosphates, opium, alcohol, etc.; and its action is more prompt and certain than that of hygiene alone, or that of suggestion, or electricity.

The Curiosities of Tinned Foods

have formed the subject of a communication to the *Lancet*. A correspondent has submitted to the editor of that journal for examination a living creature which he states was obtained from the inside of a tinned pineapple. The fruit had been boiled at Singapore previously to tinning it and was then imported to this country. On the tin being opened a living insect of strange and unknown appearance was found inhabiting the inside of the pineapple. On examining the insect it was found to be the larva of some beetle the species of which could not be accurately ascertained; consequently it was impossible to say with certainty whether its natural food was vegetable or animal material. It is quite possible, however, that the statement regarding the cooking of the pineapple may be correct; for the fruit might have been imperfectly or incompletely cooked. In that case the temperature of the interior might never have reached so high a degree as to cause coagulation of the living tissues or of the structure of the egg or larva. The power of many insects and mites to resist both high temperatures and the action of many poisons is well known and exceedingly remarkable. Thus the seed of the nux vomica, deadly to most animals, forms the appropriate food of certain beetles. Goats, again, are well known to have no special aversion to hyoscyamus, of which the vile-smelling henbane is the most deadly species, as an article of diet. There is, of course, always the possibility of error of observation and of the introduction of the insect after the fruit has undergone the process of preservation.

A Practical Water Tricycle

has just been patented in Chicago. The vehicle consists of an ordinary tricycle frame, between the wheels of which are fitted two boat-shaped floats. These are water proof and cannot sink. They are composed of patent leather, covered over with pitch, and varnished and filled with cork, making them as light as possible. The entire machine weighs seventy-five pounds and floats easily on the water. The power is transferred to the wheels by the regular pedals and link chain, and the large wheels are fitted with paddle blades. The machine is steered by the front wheel, which is fitted with zinc, making it a rudder. It is claimed that the outfit is most practical, and that it has been amply demonstrated. The tricycle runs as well on land as on water, and this is certainly a useful feature. You can ride to your lake, and when you get there ride out in the water, and there you are, no boat, no trouble. The boat attachment can be easily removed by drawing a few pins, and the tricycle can be used for the road. It works as well on dry land with the floats, however. It is intended to make one of the machines with aluminum floats, as this would greatly lighten the vehicle and increase the speed. The floats are 6 feet long, and look like small canoes.

The Proper Weight of a Person,

details of which were given in a recent issue, has led to inquiries for fuller information about the proportion of health from numerous female correspondents. We therefore give the following generalties, which it must be understood are governed by different circumstances in different cases: A woman should weigh two pounds to every inch of stature she has attained. Thus, the woman 5 feet 4 inches in height should weigh 128 or 130 pounds. The chest measure of such a woman, taken above the bust and beneath the arms, should be 30 or 31 inches, with a power of expanding $2\frac{1}{2}$ or 3 inches when the lungs are filled with air. The upper arm should measure 10 inches and the lower arm 8 inches. The waist should be 25 inches in circumference, and the chest diameter, which means the distance through the body from the chest to the back, should be 6 inches. This diameter is more frequently lacking than any other, while the

diameter of the abdomen, taken in the same way, is usually larger than the average and larger than the chest diameter, while the reverse effect is desirable. The average results of the physical measurements of 325 girls and women, averaging 194 years of age, are as follows:

Weight	117.5		
	Inches.		*Inches.*
Height	64.0	Girth – Hips	35.2
Girth – Chest	29.2	Upper arm	9.5
Full	31.2	Fore-arm	8.7
Ninth rib.	26.2	Depth chest	5.9
Full.	27.9	Depth abdomen	6.1
Waist	22.7	Tests—Cap. lung. 135.4 c. in.	

Characteristic Defects

may be readily computed for these details. Another important test made is the capacity of the lungs, which should be able to blow from 150 to 175 cubic inches, and, as will be seen from the table, the average lung capacity is only 135.4 cubic inches. The effect aimed at in any sensible system of athletics for women, is not abnormal development of one muscle, or set of muscles, to accomplish prodigious feats of strength, but the development of the entire figure to roundness of contour and symmetry, which in stout women invariably gives an effect of smallness in size, and the training of the muscular system in such a way as to give it elasticity in action and to give its owner power and control over such action.

A Meteor said to be Half Gold

has just fallen in the Bruneau Valley, Owyhee County, U.S.A., but like most Yankee yarns we take this one with a biggish grain of salt. The meteor is described as "shooting earthward out of south-western heavens" and illuminating the country for miles. It appeared as large as a railway carriage, and as it slanted downward it emitted alternately a deep red and a dazzling white light. Mr. John Roland, the observer, said he could hear a humming noise as it dropped through the air, and occasionally there was a sound as of the distant explosion of small fire crackers. He saw the meteor pass down behind the dark outline of a high hill, and a few seconds later he heard a sharp and resonant explosion. Within the next few moments Mr. Roland saw six smaller ærolites shoot through space, but he could not tell if any of them struck the earth. After the fall of the big meteor the air was charged with electricity, which so afflicted Mr. Roland's horses that they became sick, staggered, and fell down vomiting and snorting.

A Search Resulted in a Grand Find

of a meteoric stone, weighing probably 400 lbs. which had struck a sand-bank on the margin of a creek, and had then ricochetted 90 feet to a bluff of clay, where it had lodged. After considerable effort, a piece of stone was chipped off. It had the appearance of half smelted iron ore, but an assayer has assured the finder that the stone is rich in gold. Another witness declares that he was not over 1,000 yards distant from the meteor when it struck the earth, and that he felt the heat and electric atmosphere which surrounded the incandescent bolt. When he arose next morning and started to search for the fallen star, as he termed it, he found stumps and boulders sprinkled with fine sand, and conjecturing that the meteor must have landed in or near the creek, he proceeded to the stream and soon discovered what he sought. The stone will be hauled to the railroad and shipped to Denver, the finder being unwilling to part with it for scientific purposes. He thinks the meteor, which is extremely heavy, is more than half gold.

An Electric Fly Trap

has been designed by a chemist. It is run by a little electric motor, and gathers in the flies with great celerity and absolute certainty. A piece of strong brown paper, about 4 inches wide and 15 inches long, is fastened in a continuous band around two rollers, which are kept revolving at a slow rate by the motor. The band is slightly smeared with a sweet substance. Two-thirds of the length of the band is freely exposed, but at the other roller it runs under a wire cone and then against a brush. The flies alight on the slowly moving band, and unsuspectingly remain there sipping the sweets until brushed off, when they fly up into the cone, from which they can find no exit. This is not dissimilar to a contrivance for destroying insects which has been successfully tested in one of the parks of Munich. A rough frame work was built, with a large electric projector at the top. At the same point was a powerful exhaust fan, operated by a motor leading to a kind of grinding mill. The insects, attracted by the light, would be drawn by the draught into a passage leading them down to death and mutilation in the grinder. In some parts of Northern Europe it is claimed that these pests have been turned to good account, the crushed insects being mixed with flour and water, and baked, the cake being used for feeding poultry.

The Vice of Bucking

possessed by American horses has, apparently, been inherited by the railway motor that has so freely supplanted equine force in the streets of trans-Atlantic cities. It sometimes happens that an electric car stops suddenly as if by a collision, usually going ahead immediately as if nothing had happened, but sometimes refusing to move further. This is known among railway men as "bucking," probably because it acts like a broncho. There are all degrees of bucking, from a small jerk, as if the car had run over a stone, to a full-sized one, that throws the passengers forward as if the car had struck a solid wall. Our authority for this paragraph knows of two instances where it has thrown the motor man over the dash into a dangerous position, but he has never heard of any case where the passenger received the slightest injury, beyond a lively jolting. Bucking is, however, not very common, and probably most people who patronise the electric lines never heard of such a thing, or, at least, never experienced a real case of it. The cause of the action is really very simple. In most cases a ground occurs from some reason in the field, which, in the ordinary series railway motor, is between the trolly and the armature. The current thus goes to ground without passing through the armature, and the armature is practically short-circuited in a very intense field. The result of this is, of course, that a powerful current is generated which tends to run the motor in the opposite direction and pulls up the car with a sudden jerk. Sometimes this short circuit is only temporary, and the motor will immediately recover itself.

The Lost Art of Casting Glass

has been discovered, it is claimed, by a Mr. R. G. Cupteli, a prominent glass manufacturer. It is known to have been practised by the Egyptians. He has interested capitalists in his invention, and has erected a factory at Pendleton, a small town near Anderson, Ind. (U.S.A.), and recently made his first cast with success. The glass tubes are suitable for sewer, gas and water mains, and are joined by a glass cement, also the invention of Mr. Cuptell. The factory is a large one, and all opertions are conducted with the greatest secrecy.

GLEANINGS OF THE GLOBE.

ROLLER skates were invented by Plympton in 1863.

AREOMETERS were first described by Baume in 1768.

ENGLISH books were first printed by Caxton in 1474.

THE first iron wire was drawn at Nuremberg in 1351.

COVERED carriages were first used in England in 1580.

BLASCO DE GARAY built a steamship at Barcelona in 1543.

GIAMBATTISTA, 1601, made a steam pump for mining use.

DE CAUS, 1615, published an account of a machine run by steam.

THE Marquis of Worcester constructed a spherical copper boiler in 1663.

THE Leyden jar was invented by Kleist in 1745, the battery by Winckler.

GIOVANNA BRANCA, 1629, described how propulsion by steam could be accomplished.

SULZER, in 1762, detected the sensation in the tongue by contact with silver and lead.

A GLASS plate was first used in an electrical machine in 1770, and rubber amalgam in 1771.

FRANKLIN'S theory of electricity and lightning was demonstrated in 1752, by means of a kite.

TO be perfectly proportioned a man should weigh twenty-eight pounds for every foot of his height.

FRENCH reporters now take notes at night by the light of a tiny incandescent lamp attached to the pencil.

A VERY powerful electrical machine set up by Van Maarem in 1751, at Harlem, was pronounced dangerous.

IT is not generally known that an orange hit in the exact centre by a rifle ball will vanish at once from sight. Such, however, is the fact. Shooting it through the centre scatters it in such infinitesimal pieces that it is at once lost to sight.

A NOVEL envelope has been brought to our notice, of which the peculiarity is that the flange, which is short, folds on the face or address side, the object being to afford security against tampering with the fastening by affixing the postage stamp partially over the flange.

THE remarks that have appeared in these columns respecting electric appliances do not refer to those manufactured by J. L. Pulvermacher & Co. We have tested these belts and find that they do generate a current of electricity, but we have no knowledge of their curative powers.

DURING the recent intense heat, many of the female hands in the ammunition factory at Spandau, near Berlin, fainted. It was ascertained that most of these cases were due, not to the heat alone, but also to tight lacing. The wearing of corsets during the hours of work is now forbidden on pain of fine.

EXPERIENCE shows that the life of incandescent lamps, particularly those having long, thin filaments, is materially shortened by mounting them in either a horizontal position, or, as is frequently done, in a position upwardly inclined from the horizontal. This effect is especially noticeable in buildings subject to vibration from surrounding machinery.

DARWIN states in his "Voyage of a Naturalist," that unless the huanacoes, or wild llamas of Patagonia, drink salt water, in many localities they must drink none at all. The large and interesting group of sloths are alike in never drinking. A parrot is said to have lived in the Zoological Gardens, Regent's-park, for fifty-two years without a drop of water.

THE ancient Germans, according to Tacitus, had a delicious drink made of honey. It was called "mead," and newly wedded couples drank it as a beverage, and set it before their friends for a month after the nuptial ceremonies had been performed. For this reason the period of four weeks following the marriage is called "the honeymoon" of the happy couple.

HELENA, Montana, U.S.A., will send to the World's Fair a meteor, discovered near that city. It is composed of nickel and magnetic iron, and is in two pieces of ninety and seventy pounds respectively. It is reported that when found these pieces were in a hole in the ground large enough to contain a house, from which fact it is inferred that the meteor exploded when it struck the earth.

IF the child has swallowed anything that cannot digest, particularly if it is sharp, let him eat immediately two or three pieces of dry bread. This is very apt to surround the object swallowed with a sort of coating. In addition let the food for several days be more solid than usual, and under no circumstances give purgative medicine. The chances are that the child will feel no trouble from the carelessness.

A FRENCH statistician, taking the mean of many accounts, asserts that a man of fifty years of age has slept 6,000 days, worked 6,500 days, walked 800 days, amused himself 4,000 days, was eating 1,500 days, was sick 500 days, etc. He ate 17,000 pounds of bread, 16,000 pounds of meat, 4,600 pounds of vegetables, eggs, and fish; and drank 7,000 gallons of liquid, namely, water, tea, coffee, beer, wine, etc., altogether.

MANY persons are disposed to call petroleum coal oil, under the impression that it comes from coal and has a vegetable origin. That is not, however, the view, commonly, of geologists and other scientists. They hold that it is of animal origin and comes of the fat of the animals whose remains were, ages ago, covered with sediment at the bottom of the sea, which sediment was subsequently solidified into sandstone and other kinds of stone. The geological conditions of the occurrence of petroleum suggest its animal origin. Engler produced an artificial petroleum from animal fats.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not satisfactorily replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 48.

211.—What is daylight?

Daylight consists of exceedingly complex motions in the ether or imponderable fluid with which all void space is filled. The cause of this irregular commotion, which only obtains near to the sunlit surface of the earth or a similar planet, is the existence, floating in very close proximity to one another, of an enormous number of minute particles of oxygen and nitrogen, which, collectively, we term the atmosphere. Our sun throws off its energy in the form of transverse waves, *i.e.*, oscillations taking place at right angles to the direction in which they are propagated. When these regular waves impinge upon the multitudinous particles of the air they are to some extent shivered into what may be called by comparison light ripples, and to a still greater extent they are scattered about in all directions by irregular reflection from the surfaces of the particles. An observer situated far above the limit of the earth's atmosphere might compare this process to that by which an unruffled column of falling water is dashed into visibility as it strikes a rocky bed. As a matter of fact, such an observer, although placed in the full blaze of the sun would be able to distinguish no light whatever, except, on the one hand, by turning his eyes directly upon the sun's disc, or, on the other, by looking down upon the daylight with which our atmosphere is imbued. Daylight, as we understand it, has no existence in interplanetary space.

212.—What is the poisonous firedamp met with in coal mines?

This is a colourless gas, otherwise known as marsh gas. It is very slowly given off by the vegetable matter in bogs, and may be evolved even during the natural processes by which such matter is converted into coal. In this last case the escape of the gas is, of course, prevented by the overlying strata of clay or rock, and so it remains pent up until released by the excavations of coal miners. Mixed with air it is almost as violently explosive as a similar mixture of common coal gas. One of the products of its combustiou or explosive being "choke damp," *i.e.*, carbonic acid.

213.—What is the principle on which lithographic printing is based?

The art of lithography depends upon the mutual antipathy of grease and water. A design is made in greasy ink upon a porous surface. All those parts of the surface remaining unsaturated with grease are then thoroughly wetted with water (preferably with a weak solution of gum water). After this treatment a wet sponge and a roller charged with greasy ink may be passed over the surface any number of times successively. The ink "takes" only on the greasy portions of the stone and the wet sponge maintains the grease repellant character of the other portions, upon which no ink must be permitted to attach itself.

214.—What is the origin of the beautiful designs seen in snowflakes under the microscope?

Snow is simply ice, that is to say, solidified water in a crystalline condition. Prof. Tyndall has shown that a block of ice might almost be considered as an assemblage of closely compacted interlocking crystals. The isolation of these crystals during the liquifaction of ice can be recognised by the aid of a microscope. What is the nature of the molecular forces which determine the production of crystalline form it would be difficult to say. That they are governed by invariable laws is proved by the fact that in some instances difference of crystalline form is the only known distinction between different but closely allied chemical substances. And in all cases the forms of crystalline bodies furnish important evidence as to their chemical constitution. Amongst other liquids which, like water crystallise on solidification, may be mentioned melted sulphur and melted bismuth, besides innumerable supersaturated solutions of salts.

215.—What is the most successful or promising method of ærial navigation?

It cannot be said that any method hitherto attempted has been very successful. The most promising method is, it appears to the writer, one depending on the employment of an ærial screw propeller. It is a mistake to suppose that the natural flying apparatus of birds ought to be copied exactly. The rational course is to adapt the motions and strains in any piece of machinery to the peculiarities of the materials from which it must be made; and steel, wood, and aluminium are practically the only materials available for the construction of ærial mechanism. The great difficulty consists in the want of a sufficiently powerful, and at the same time light motor. The most promising method for overcoming this difficulty that has been hitherto brought forward appears to be embraced in the suggestion that an electro-magnetically inductive system should be laid down in the line of route, and that the polarity of this system should be frequently reversed by alternating the direction of the current, so that an electro-dynamic motor on the airship would be supplied with energy. In this way it would be quite possible to make an "airship" skim over the surface of the ground, or at a small elevation, with great rapidity.

216.—What is the distinction between pebble and glass spectacles?

Genuine pebble, or rock crystal has two striking advantages over common or crown glass for spectacle lenses—its brilliancy and its hardness. The principal objection made against the use of pebbles is their double refraction; but this is seen only in thick pieces when we look through their slightly inclined surfaces. Objects thus seen through polished planes of massive pieces appear double, which is not the case with thinner plates like spectacle lenses. Crown glass, which is the kind commonly used for spectacle lenses, is a hard glass, sufficiently clear for optical purposes, but it shows edgewise a greenish tint. The mixture of arsenic and manganese with the glass in melting may do much to remove this, but early corrosion is thereby favoured. Pebbles are more suitable for hypermetropia (or long sight) than for myopia (or short sight), as their high refractive index causes a glare which is undesirable with the latter ocular defect.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

223.—How many particles of gas are there in the whole of the earth's atmosphere?

224.—On what general lines is the national survey of a country carried out ?

225.—Of what use is the ophthalmoscope ?

226.—Is it dangerous to drink cold fluids when in a heated condition ?

227.—Why does palpitation of the heart often follow indigestion ?

228.—What is the difference between an atom and a molecule ?

HOW MICROBES ARE KILLED.

Bacteriologists are actively engaged at present in following out a line of experiments, which is destined to soon bring forth most astonishing results. All mankind must needs be interested in the subject, because it signifies the discovery of means for preventing and curing many of the most fatal diseases to which flesh is heir. The investigations are being conducted very quietly, lest the public mind be prematurely stirred up over the matter, thus doing more harm than good, as was the case with Koch's famous "lymph."

The trouble with the lymph was that it was brought out before it was ready. Other physicians were so afraid that Dr. Koch would anticipate them in the field of discovery that they extorted his secret from him and forced him to make his achievement public before it was fairly accomplished. Immediately there was a cry from all over the world for the new remedy—a cry of despair freshly inspired by hope, which could not be refused. Reluctantly the inventor was compelled to set to work and manufacture his imperfect preparation in quantities for distribution everywhere. That it failed to accomplish the wonders expected of it is not surprising.

Profiting by this experience, Dr. Koch and his assistants have been pursuing their investigations secretly in the same direction, publishing nothing on the subject and saying very little. It can be stated with authority that they have obtained some great results. The statement may even be made that they have found out how to cure consumption, if it shall not have progressed too far, as well as other complaints of a tubercular nature, like lupus. But nothing about the matter will be made formally public until evidence that is beyond disputing can be pointed to in the shape of sick persons restored to health, with the history of each case in detail accompanying.

Experimental researches in this line have been carried on for more than a year past by many bacteriologists elsewhere than in Berlin. It has been recognised from the first that the lymph was a great discovery, but it was valuable rather in theory than in practice, because it was too crude. Besides the curative agent, it contained a fever-producing poison that was in itself dangerous to life, as well as other undesirable ingredients. Therefore, the experts have directed their efforts to separating the actual remedial substance from the other parts. Injections of this will destroy the tubercle bacilli in the lungs or elsewhere without causing any reaction in the shape of fever or otherwise doing any harm to the patient.

To make all this perfectly understood it is only necessary to explain in a few words the idea which is at the bottom of the lymph and also of similar remedies for other troubles, which will soon be embraced in ordinary medical practice. Why do people ever recover from such complaints as pneumonia, typhoid fever, and diphtheria? One would think that the disease germs would always go on multiplying indefinitely until they killed the patient. Luckily, however, in feeding on the tissues of the body and thus causing various morbid symptoms, they secrete incidentally a poison that is fatal to themselves. When enough of the poison has been produced it destroys the germs and the victim gets well, supposing that death has been kept off long enough. Each species of "pathogenic" germ secretes its own peculiar poison.

Now, the bacteriologists believe that, if they can isolate these germ-destroying poisons, they can utilise them to kill the germs in the human body by injecting them into the circulation. Precisely that idea is the basis of Koch's lymph, only that this preparation was not properly made, as has been said. It contained at least one undesirable poison in addition to the one that was wanted. When the true antitubercular poison is obtained in a pure state by itself, as has probably been done already by Dr. Koch, a sure remedy for consumption in its early stages, as well as for lupus at any stage, will have been secured.

Before very long other lymphs, which are now being experimented with in laboratories here and abroad, will be employed in the treatment of scarlet fever, lockjaw, diphtheria, carbuncle, typhoid fever, typhus, and pneumonia—all of them complaints caused by bacteria. From nearly all of these it is found that rabbits and guinea-pigs can be rendered immune—that is, incapable of contracting them—by the peculiar poisons above described. It is reasonable to suppose that the latter will operate with equal effectiveness in the case of human beings. Towards the curing of the same diseases by like means, when they have been acquired, important steps have been taken. At a lecture delivered the other day photographs were exhibited of rabbits which had been made very sick by inoculation of tuberculosis of the eye. To show how efficacious the remedy employed had been, the animals themselves were displayed in their cages perfectly restored to health.

The method by which these poisons are obtained separately is too elaborate for description here. A bit of diseased flesh from a person or animal that has died of a bacterial complaint is touched with a platinum needle that has been previously heated for the purpose of destroying all other germs upon it. The needle is then introduced into a glass tube partly filled with gelatine that has been sterilised by boiling. On this nutritious medium the bacteria at once begin to feed and multiply with great rapidity, so that within a few hours there is a discoloured patch composed of myriads of them on the surface of the gelatine. These artificially propagated microbes are taken and put through a complicated chemical process, so as to get rid of the germs themselves and secure separately the poison which they have secreted while feeding on the stuff in the bottle. And this poison is the curative agent elaborated by nature for the purpose of annihilating the germs and killing the disease they cause.

VOLUME I. OF "SCIENCE SIFTINGS"

CAN BE HAD.

Bound in Cloth and Gold, 3s. 6d. Postage 6d. extra.

Or from Messrs. W. H. Smith & Son,

and through any Newsagent.

SPEAKING ALONG A RAY OF LIGHT.

A most important element is selenium. The word itself comes from the Greek for the moon. It is a comparatively rare element, occurring most abundantly in iron pyrites from Fahlum, in Sweden. These pyrites are used in the manufacture of sulphuric acid, and from the waste product of the process the selenium can be separated out. Selenium, like sulphur, occurs in several allotropic forms, three of which are known at present—a red amorphous variety, a black vitreous form, and a crystalline form, the last being the most important.

The most remarkable and important property of selenium is its relation to the forces of light and electricity. Vitreous selenium is a very bad conductor of electricity, but the crystalline variety is a fairly good conductor, and, what is very remarkable, conducts better in light than in darkness, that is, the action of light-waves falling upon a piece of crystalline selenium is to decrease its electrical resistance. On this property is founded the wonderful photophone invented by Mr. Bell, by which the human voice can be transmitted over long distances without any wire or other connection except a ray of light. A brief description of this instrument may be of interest.

The transmitter consists essentially of a vibrating diaphragm, to which is attached a mirror, which reflects a ray of sunlight to the receiving station. The receiver consists of an ordinary telephone, connected with a battery and disc of selenium, so that a current of electricity passes continuously through the telephone and selenium disc. The disc is placed so that the beam of light reflected from the transmitter falls directly upon it. The telephone may be placed in any convenient position.

Now, if a person speaks into a transmitter, the disc and mirror are thrown into vibrations corresponding to the spoken words, and consequently the intensity of the beam of light varies in a similar way. As these light-waves of varying intensity fall upon the selenium disc at the receiving station, its electrical resistance varies, and the strength of the current passing through the coils of the telephone is correspondingly changed many times a second. This current of varying intensity, acting through the electro-magnet upon the diaphragm of the telephone, reproduces the words spoken at the transmitting station, in exactly the same way that an ordinary telephone message is reproduced, except that an immaterial ray of light has acted as the carrier of the articulate sounds instead of a metallic wire. The possibility of such a result is almost beyond belief, but it is an actual fact; and, after all, it is really no more wonderful or incomprehensible than the transmission of an ordinary telegram or telephone message, which are matters of every-day life. We use these mysterious forces of Nature for our own benefit, but we really know nothing about them except that they exist.

Although established as a scientific fact, the photophone has been of no practical use, being too delicate and uncertain an instrument to be generally used like the telephone. It offers, however, a hint of immense possibilities. A photometer, depending upon the varying resistance of selenium, has already been invented, by which the luminous power of different lights may be accurately compared and measured. Inventors have long been searching for a method of transmitting luminous rays, so that we may see our friends at a distance as we now hear their voices. While this may be theoretically possible, there seems but little chance that it will ever be practically realised; but if it is, it will undoubtedly be effected by the mysterious relation between ght and selenium.

HOW PAPER IS MADE FROM WOOD.

In none of the mechanical arts has greater progress been made in recent years than in the manufacturing of book and magazine paper. Years ago, though not too long to endure in the memory of "the trade," the process of converting the raw material into the hard-fired and smooth-surfaced paper essential to the needs of the higher class publishing houses was a task involving many days of constant care and much manual labour. To-day the process is extremely rapid, the paper is infinitely better than before, and much of the manual labour that was employed in the days of our fathers has been supplanted by the labyrinths of swift moving machinery.

It would be difficult to imagine a more surprising metamorphosis than that by which timber is converted, in seven hours, to a sheet of clear white paper ready for the press. Yet this, in brief, is the process that is going on at a mill that we recently inspected. This mill is the largest book-paper-making establishment in the world. It covers several acres of ground and almost as many acres of machinery. Sixty cords of timber are thrust into the choppers, and 90,000 pounds of paper are shipped from the yards every day to be cut, printed and placed in countless libraries throughout the land.

The chopper, where the conversion of wood into paper begins, is a sort of guillotine. There is a sharp blade of massive proportions, moving swiftly in a groove. Everything that comes beneath the knife is severed. Occasionally a tough knot that has withstood the blasts of many a winter is tossed in, only to suffer the fate of the sapling that went before. Every stick that goes in comes out in the shape of chips no larger than a man's hand. The wood does not lose its identity, however, until the next stage of the process, which is known as "cooking." There are several large digesters, containing caustic soda, in which the chopped wood is placed and cooked for five hours, this being the longest single process to which it is subjected. From the digesters it is blown into a large tank, its consistency being thick and heavy, and its colour an ugly brown.

The soda having been run out, the pulpy cooked wood in the tank is washed down with hot water and thoroughly cleaned. Then it is dumped into a large chest, cleaned again, and, having been pumped into a screen which romoves splinters and debris, it is run into wet machines and in a measure dried. The "stock" emerges from these machines an unbroken sheet of light, brown pulp, resembling soaked birch bark. As it falls from the machines, it is taken on carriers to four bleachers, each holding 4,000 pounds. Here it is treated with chloride of lime liquors until the desired whiteness is obtained.

By this time one begins to see how it is possible to make paper from wood, for the "stock" has already assumed a beautiful white colour, and its consistency is of a soft, pulpy sort, very much like boiled starch and not at all like wood. Squeezed in the hand, however, there remains a dense fibre that clearly shows the stuff of which paper is made, and establishes the link that binds the pulp in the tank to its parent timber on the neighbouring hills.

A pulsometer pump, close by the bleachers, next drives the white mass into 15 large storechests, each holding 8,000 pounds. It is held in the chests until the beating engines are ready to give it a shaking up, preparatory to its final transition. The stock, which is now called "half-stock,'

here receives its colouring material and sizing. If blue, yellow, pink, or other colour is desired, this is the stage in the process where the colouring material is applied. The "sizing," which consists of resin and an alkali boiled together, is used to give the paper the desired resistance to atmospheric influences. An alum is used, which separates the alkali from the resin in minute particles, and while passing through the calenders or the paper machines it fuses, thereby completely covering the sheet with a film, which effectually resists the influences of the atmosphere. Clays are used to make the paper opaque.

From the beaters the "half-stock" is passed into a large chest holding 4,000 pounds, containing an agitator turning at the rate of 12 revolutions a minute, and thus keeping the stock in a uniform condition, preparatory to its passage to the refining engines. These engines, two in number, supply a 106-inch paper machine, which marks the beginning of the end of the metamorphosis. Having passed through a sandcatcher to a receiver or mixing box, the stock finds its way to the great Fourdrinier machines. Still in a liquid state, it is passed to an endless wire screen and a vibrator, where the water is then taken from the partially-formed paper by means of three suction pumps. This screen contains 70 meshes to the square inch, and is 40 feet long. By the time the stock leaves the screen, its transition to the paper state is clearly defined, though there is still a long line of humming machinery through which it has to pass. The primary stages, however, are over.

A ten-inch "dandy" roller now gives the paper the same shape and surface both sides, and, if necessary, supplies it with the watermark. Then it passes to two couch rolls covered with woollen jackets, and then to a 32-feet endless wet felt, where the remaining water is pretty effectually pressed out. As there is some water remaining, another felt press is resorted to, and then the paper is ready for the drying cylinders, 15 of which, each 48 inches in diameter, and heated by steam, relieve the paper of the last of its moisture. A cloud of steam rising from these cylinders, as they slowly revolve with their white coverings, shows that some moisture still remains. But the cloud grows less and less dense as the last of the cylinders is reached, and by the time the paper reaches the calenders it is as dry as a bone.

These calenders are chilled-iron rollers, which give the paper its desired finish. From these it passes to six revolving reels and then to the cutting machines, where it is cut in any shape or size preparatory to shipment. While this interesting process is going on, the caustic soda, used in cooking the wood originally, is by no means forgotten. This soda is somewhat expensive, and about 65,000 pounds of it would be lost if it were not recovered. Accordingly it is drained through the bottom of the tank, to be subjected to a remarkable series of processes which eventually restore it to its original condition and to 90 per cent. of its original volume.

From the storage tanks it is filtered through sand, and then run to a boiler where it is heated to 170 degrees preparatory to insertion in the evaporating machines.

These machines may be said to have revolutionised not only the paper making industry, but every other industry as well in which processes similar to that of the recovery of the caustic soda are involved. The machine contains 22 coils traversing their entire length. The liquor enters the coils at 22 different places, and travels through each "effect" five times. Then it passes out into the head, drops down, and goes through into the second effect, while the steam passes out. Thus, the steam arising from the hot liquors helps evaporate the liquor in the second effect, where the operation in the first effect is repeated, the steam passing around the flues and the liquor passing through them. By the time the third effect is reached the liquor is of the consistency of molasses, containing a very small percentage of water, and consisting for the most part of soda and resin.

After leaving the third effect it passes into a store tank and is drawn off into four "rotaries," which are simply revolving cylinders, eight feet in diameter, lined with firebrick. The liquor runs in at the back of these cylinders and coats the inner surface, while a natural gas flame at the front sets it afire. In this way the resinous substances are burned out completely, so that when the erstwhile liquor emerges at the front end of the rotary it is a cherry-red ash, consisting of carbonate of soda mixed with the carbon of the burned resin. Dropping from the rotaries to an endless chain, the ash is carried up to the bleaching battery, consisting of six tanks, in which the soda is bleached out of the ash by hot water.

TO WHAT DOES THIS REFER?

We will send 5s. to the sender of the first letter containing the correct answer opened by us on Thursday morning.

The following paragraph appeared in the current issue of our contemporary the *Electrical Review*. It is a very spicy edition, and we recommend everyone interested in—well, never mind—to purchase a copy. This is the paragraph to which our 5s. gift refers :—

"To get at the public, so as to protect them, is most difficult; the *Daily Press* is, unfortunately, too interested from an advertisement point of view, to enter into the matter. We are pleased, however, to note that SCIENCE SIFTINGS has entered into the arena to do battle against this imposture. We heartily wish it success, and although it may take time, we feel little doubt but that perseverance will eventually command it, and that what is, undoubtedly, a grave scandal, may at last be unveiled in all its grossness, and the promoters and abettors brought to book."

A SIMPLE EXPERIMENT IN ANALYSIS.

Gunpowder, as is well known, is composed of potassic nitrate (saltpetre), sulphur, and charcoal. Of these ingredients, the first is very soluble in water and the others insoluble; and the amateur chemist can perform an interesting experiment by separating out the soluble salt. It is only necessary to place a little gunpowder in a glass half filled with water, and allow it to stand for a day or so in a warm place—such as a sunny window-sill. The saltpetre will first dissolve in the water, and then, creeping up the sides of the glass, will crystallise around the edge. This creeping property of certain salts is a very interesting—and sometimes a very annoying one—to the chemist. Ammonic chloride, or sal ammoniac, possesses it in a high degree, and it may often be observed incrusting the edges of electric batteries in which its solution is used as an exciting agent. It may be prevented by covering the edge of the vessel containing it with grease, wax, or paraffin.

The residue left in the tumbler consists of sulphur and charcoal, but there is no simple method of separating them. The sulphur will dissolve in bisulphide of carbon, but we cannot recommend the use of this inflammable and offensive liquid to the amateur in chemistry.

SIFTINGS OF THE STUDY.

Digestion and Diet.

By Thomas Dutton, M.D.

(London: Henry Kimpton and Hirschfeld Bros.)

As the author points out in his preface, this is not a medicinal work in any sense, and, therefore, we can highly commend it to the general reader. He will find nothing contained in it but what will assist him, in conjunction with his own common sense, to lay down such useful rules for his own dietary as will save him from nearly all the ills to which flesh is heir. We have often pointed out in these columns how much the advance of man is due to our improved methods of cooking. This theme is enlarged on by Dr. Dutton, who claims that the art of cooking and dieting has nearly reached the level of a science. What is of more importance still is the author's belief, which we cordially share, that in our treatment of disease we should depend as much on diet and cooking as on the use of drugs; for a man or woman who takes a sufficient amount of properly cooked and suitable food at regular intervals, as well as a regular allowanee of drink, and keeps the muscles and skin healthy by judicious exercise and bathing, will find that nutrition and assimilation will go on without the least trouble or discomfort, and the pangs of indigestion be unknown. The methods to attain this *Ultima Thule* of physical happiness, where heart and liver complaints, gout and obesity are unknown, may be acquired by a careful perusal of Dr. Dutton's *brochure*, and by studiously and intelligently following the precepts laid down, which, after all, are not so very irksome in view of the tremendous gain.

Sea-Sickness: Cause, Treatment, and Prevention.

By Thomas Dutton, M.D.

(London: Henry Kimpton and Hirschfeld Bros.)

Although Dr. Dutton has prepared this work mainly for the busy practitioner and ship surgeon, it will be found of immense service in the hands of any voyager or invalid. To the latter it will be especially welcome, since it contains most interesting chapters on health resorts, voyaging for health, and advice to invalids, the first of which has not appeared in the previous two editions of the book. As regards sea-sickness, it is interesting to note that English people suffer less than most nations. Nevertheless, we suffer quite enough, and a few hints for the alleviation and prevention of *mal de mer* from such an authority as Dr. Dutton must always prove welcome to the traveller. He has found all the quack remedies fail, and he supplants them with a preventive treatment that commences at least a week before starting for a voyage. This is practically the whole secret of prevention: Put the whole system in order before starting. After starting attend to the diet. We have decided after reading Dr. Dutton's plausible chapters never to be sea-sick again.

Modern Science in Bible Lands.

By Sir J. William Dawson, C.M.G., etc.

(London: Hodder and Stoughton.)

The lover of ancient history as well as the naturalist and geologist will find in "Modern Science in Bible Lands" a book of absorbing interest. The writer takes us through the entire history of the Bible from Genesis to the New Testament, dealing with such incidents and narratives as afford him scope for dwelling upon the natural history, geography, and geology, associated with those passages. Sir J. W. Dawson has studiously and wisely avoided that quicksand "The Reconciliater of the Bible and Modern Science," and deals merely with Bible incidents as he finds them, making the history a peg, if we may use the term, upon which to hang his lucid and correct observations. Whether Sir J. W. Dawson is discoursing on the ethnology of the ancient Egyptians, or the topography of the Books of Exodus, or on the geology of the times of primitive man, he is equally interesting. The book when once taken up will be read with eagerness by all lovers of science, whatever their opinions or differences upon points of religious belief or scepticism may be.

Electrical Engineering as a Profession.

By A. D. Southam.

(Whittaker and Co: London and New York.)

This book is calculated to supply to those who contemplate entering the electrical or engineering profession, much pertinent and useful information that cannot otherwise be obtained without considerable expense and trouble. The *pros* and *cons* of an electrical training by apprenticeship to a firm and, by a course at a technical institute, are discussed and full particulars are given of many typical courses of training. To parents who intend to place their sons in electrical works, and to young men who can afford to pay for tuition in the theory and applications of electricity, this book will be simply invaluable. Some particulars are also given by Mr. Southam of "The American System" of apprenticeship, etc. The American system may be shortly described as an embodiment or illustration of the law of the "survival of the fittest." That this law is not enforced in the new world exclusively is a fact that will no doubt impress itself in due course upon many aspirants to success in the newest and apparently one of the most attractive of the professions.

A Minimum Wage.

By Alfred Morris.

(Cassell and Co., Limited: London, Paris, and Melbourne.)

This pleasantly written and interesting book is described by the author as "a socialistic novel." Mr. Morris' ideas with reference to social questions are presented in the form of a story "containing characters and scenes from real life." The conclusion Mr. Morris arrives at, that nothing but State intervention with regard to the remuneration of labour will effectually solve the great social problem, is one that we are not prepared to deny *in toto*. The fact is that almost every act of government interference, of which there are many already in force, is virtually an act of intervention with regard to the remuneration of labour. That this essentially limited introduction can be exchanged with advantage for absolute government control—that a comfortable "minimum wage" can be fairly guaranteed to all workers—is a statement that may perhaps be described as controversial. That Mr. Morris' book should be read by every intelligent citizen and by every sympathiser with the victims of uncheeked immigration and improvident habits is, however, an undeniable fact.

Fifteen Months in the Moon.

By G. H. Ryan.

(Published by the Author: Hornsey, London, N.)

A journey to the mysterious unknown hemisphere of the moon affords to Mr. Ryan full scope for the imagination of men, manners, and institutions of the most improved socialistic type. Perhaps from a strictly scientific point of view, the probabilities are against any marked dissimilarity

between the lunar hemisphere with which astronomers have made us so familiar and that on which observational reasoning has not been hitherto brought to bear. There is, however, a distinct possibility to the contrary. And this Mr. Ryan has expanded in a very entertaining manner. He leads the hero of this adventurous journey to the moon through a series of most sensational experiences, and even brings him, in conclusion, upon the verge of a condition of (lunar) connubial bliss.

Elementary Physiography.

By R. A. Gregory.

(Joseph Hughes: London.)

This is an elementary text book "of the laws and wonders of Nature." It describes and correlates the fundamental principles of dynamics, chemistry, geology, physical geography, and astronomy. Other branches of science are incidentally touched upon, all the explanations being given in a simple and interesting manner. The illustrations are excellent, and, in short, we can recommend this book as one of the best introductions to the study of physical science now extant.

Practical Observations on Agricultural Seasons.

By Wm. Wilson, Junr.

(Simpkin, Marshall. and Co.: London.)

This little treatise on field botany, which has now reached its second edition, needs no recommendation to the attention of intelligent farmers and others interested in agriculture. Mr. Wilson is a well-known authority on the subject treated of; and his book fulfils one of the requirements of the scientific agriculturalist in a unique and unexceptional manner.

TIME MEASURED BY INCENSE.

There has recently been added to the collection of folk objects in the museum of the University of Pennsylvania, a package of incense, the use of which survives in the rural districts of China for the purpose of measuring time. It is called kong kcung, or "clock incense"; the word kong being our familiar English word "going," which we got from the Chinese. It is used by the watchman, whose watch at night is divided into five parts. Five of these sticks are burned during the night, and they are shortened by breaking them off in accordance with the seasons. This incense was purchased at a Chinese shop in Philadelphia and is another curious instance of primitive survivals among these interesting people.

IMPROVEMENTS IN PHOTOGRAPHIC APPLIANCES.

Manufacturers of photographic specialities appear to be constantly vying with each other to reduce the bulk of portable apparatus to the very narrowest proportions. First it is the cameras, then the tripod stands, and now we have the necessary chemicals in "tabloids." This last improvement is due to the ingenuity of Messrs. Burroughs, Wellcome, and Co., of Holborn-viaduct, whose "photographic tabloids," consisting of "Quinol" developer, are achieving a deserved success. Each tabloid is sufficient, when dissolved and mixed with 30 drops of liq. potassæ, to develop a quarter plate. To the tourist who wishes to develop his plates *en route* and has difficulty in obtaining the necessary chemicals the "photographic tabloids" should prove a boon indeed.

SHOOTING INTO INFINITE SPACE.

What velocity must a terrestrial projectile receive to become a meteorite?

The reply is not very difficult. The velocity necessary to send a body into infinite space is exactly the same as that animating a body coming from infinite space to the earth, by virtue of the earth's attractions alone. It is also the same as that which would animate a body falling from the earth's surface to its centre, supposing gravity to remain the same. The velocity is 11,000 metres.

Every body thrown from the earth with a velocity greater than this would be for ever free from its attraction, and would travel for ever through infinite space, following a parabolic trajectory.

Every body thrown with a velocity inferior to this limit (but greater than 8,000 metres), would recede from the earth, describing the first half of an eclipse, then would stop, close the curve and return towards the point whence it started. It would follow an ellipse whose eccentricity would depend upon the force of projection. If the earth existed alone, immovable in space, the projectile, feeling no other influence and no disturbance, would describe a regular ellipse and would return at the end of a certain time into the mouth of the same volcano it had left. The time might be very long, for a velocity nearly reaching the limit of speed several million years would be required. It would also return to the earth with a velocity of 11,000 metres.

But our planet is not alone in the universe. The course of every projectile hurled from its surface would vary according to the direction of departure. A body thrown towards the sun would simply fall upon it. A body cast in the opposite direction from the sun would penetrate far into the depths of space, if, by an exceedingly rare chance, Jupiter, Saturn, Uranus, or Neptune were not traversing the same path, thus modifying its course. But at its return it would be attracted by the entire solar system instead of by the sun alone, and would come back towards the point of the terrestrial orbit whence it started. This would happen at each revolution, as long as the earth was not encountered to arrest and terminate its career.

If our planet formerly had volcanoes capable of throwing out such projectiles, they all, whatever their number, return and cross the terrestrial orbit at every revolution. And they reach it with the velocity of comets and shooting stars, with the velocity caused by solar attraction added to their own velocity—that is, not simply with the circular velocity of the earth's annual revolution about the sun (29,500 metres a second), but with an elliptical velocity having a maximum limit of 41,760 metres.

A meteorite coming towards the earth from the direction opposite to our revolution, may then, by this very fact itself, have a velocity of 41,700 metres, and encounter the earth moving with a velocity of 29,500 metres, giving a maximum total of 71,200 metres for the velocity of a meteorite arriving in our atmosphere. (The velocity of the earth's daily rotation may be added or subtracted according to its direction.) These numbers agree perfectly with observed meteoric velocities.

Thus, every stone thrown from a terrestrial volcano with sufficient initial force, comprised between 8,000 and 11,000 metres (the resistance of air being subtracted), would describe a closed curve, an extremely elongated ellipse, and

would thus become an asteroid in the solar system, traversing the terrestrial orbit at each revolution.

Is such force admissible ? What is the power of existing volcanoes ? During the eruption of Vesuvius, in 1822, an enormous mass of lava, weighing several thousand kilogrammes, was thrown into the garden of Prince Ottajana, a distance of nearly five kilometres. The force necessary to raise the mass and throw it so far was evidently much greater than that of our largest cannon, which throw certain projectiles with an initial velocity of 700 metres. The strange eruption of Kratatoa, August 26, 1883, threw clouds of dust seventy kilometres high, which troubled the whole terrestrial atmosphere and extended to the antipodes ! The elements in activity during volcanic eruptions being given the force required to produce the effects we are discussing would be given in harmony with the conditions at the time of our planet's ancient convulsions.

Consequently, since we find in the chemical constitution of the falling stones, fragments of the component minerals of our globe, it is possible, even probable, that these stones came originally from the earth, that they were thrown into space in times gone by, that, being freed from the earth's attraction, they gravitate about the sun, following very elongated ellipses, and that the earth encounters them and seizes them again, as they inevitably return towards the terrestrial orbit whence they started. The movement of the solar system through space does not prevent these stones from returning to us, in virtue of the well-known principle of the independence of simultaneous movements.

Nature itself seemed to have desired to put us upon the track of this simple explanation by a quite recent proof. Blocks of native iron absolutely identical with meteorites have been found on the surface of the earth. During the year 1870, Professor Nordenskiold discovered on the Island of Disko, near Ovifak, Greenland, fifteen blocks of iron, the largest of which, weighing 20,000 kilogrammes, surpasses the largest of the meteoric masses already mentioned. They were found scattered over an area of not more than fifty metres. They were supposed to have fallen from the sky, and that opinion was presented and adopted by the French Academy of Sciences. But these blocks were not meteors at all. They have been identified as coming from a terrestrial stratum and as associated with the eruptions of basalt peculiar to Greenland. On the other hand, the phenomena of terrestrial magnetism unite with geology in leading us to admit that native iron exists at the base of the whole earth's crust, several kilometres beneath the inhabited surface.

To complete the statement, let us now add that, though we consider the terrestrial origin of meteors really probable, we do not, for that reason, refuse to admit that a certain number of these stones—those, for example, which are not entirely identical with terrestrial materials—may come from some other source. If our planet has produced such projectiles, it is not an exception in the universe, and the other celestial bodies may have done the same. Thus the sun itself appears to be almost constantly surrounded by formidable eruptions of metallic gases which are thrown ten, twenty, thirty, fifty, and sometimes even eighty and a hundred thousand leagues from its surface.

September 7, 1871, the American astronomer, Young, measured an explosion, which in ten minutes, with an ascending velocity of 257,000 metres a second, rose to a height of 300,000 kilometres. At Rome, Secchi one day measured a velocity of 370,000 metres, and Kespighi cites a velocity of 600,000, 700,000, and even of 800,000 metres, and it has been estimated that a body shot forth from the sun (the resistance of the solar atmosphere being subtracted) with an initial velocity of from 430,000 metres to 608,000 metres, would not return to the sun, but would circulate in the solar system like a periodic comet, be exposed to encounter planets, and would be to the planet encountered a fire-ball or meteorite.

THE UTILITY OF FRUITS.

We know that many vegetable and fruit products are esteemed rather for their pleasant or refreshing taste, and for their anti-scorbutic properties, than for any nutritive value which they may be assumed to possess. Yet even fruits of that character are especially valuable as additions to our daily diet, on account of the potash salts and mild vegetable acids they contribute to the blood. The grateful acid of the rhubarb stalk arises from the malic acid and binoxalate of potash which it contains. The acidity of the lemon, orange, and other species of the genus Citrus is caused by the abundance of citric acid which their juices contain; that of the cherry, plum, peach, apple, and pear from the malic acid in their pulp; that of gooseberries and currants, black, white, and red, from a mixture of malic and citric acids; that of grapes from a mixture of malic and tartaric acids; that of the mango from citric acid and a very fugitive essential oil; that of the tamarind from a mixture of citric, malic, and tartaric acids; the flavour of asparagus from aspartic acid, found also in the root of the marsh-mallow; and that of the cucumber from a peculiar poisonous ingredient, called fungin, which is found in many species of fungi, and is the cause of the cucumber being objectionable to some persons.

It will be observed that rhubarb is the only product which contains binoxalate of potash in conjunction with an acid. It is this ingredient which renders rhubarb so wholesome at the early commencement of the summer, though in certain cases, known to medical men, its use may be injurious.

The following table, compiled from some analyses, shows the percentage average chemical composition of five unripe fruits and of eight ripe fruits, comprising apples, pears, gooseberries, grapes, plums, cherries, apricots, and peaches:

PERCENTAGE AVERAGE COMPOSITION OF FRUITS.

	Unripe.	Ripe
Water	85·7	78·7
Albuminoids	0·7	0·6
Sugar	4·0	12·9
Vegetable acids	1·5	1·3
Pectose and gum	4·3	3·7
Cellulose, etc.	3·8	2·8

The data thus given show that there is a considerable decrease in the watery particles of fruit as it approaches its full ripe character, resulting in a difference of 7 per cent., while the sugary constituents increase during maturation in a corresponding degree, rising from an average of 4 to nearly 13 per cent.

There is very little actual decrease in the percentage of acids from the green to the ripe stage of fruits, but the acidity becomes neutralised by the increase of sugar as the fruit approaches maturation.

Many persons know from experience how much more pleasant and agreeable fruit is when gathered and eaten

direct from the tree. This is undoubtedly in part due to the freshness and briskness of the vegetable acids contained in the fruit, which, when so gathered and eaten, have not time to change into any other substance. Stale fruit, on the other hand, is unpalatable from the very fact that it has lost this pungent and brisk taste.

Pectose forms the substance known as vegetable jelly, and it is to this constituent of fruits that jams owe their firmness. Cellulose is the fibrous part of fruits, and it is in this portion that we should find the largest proportion of mineral salts, potash, etc.

THE COST OF CREMATION.

The charge for cremation at the Woking Crematorium is, we understand, five guineas, including the services of an attendant, use of chapel, and waiting-room, and an urn for the preservation of the ashes. The railway company's charges are an extra, and the local clergyman's fee is a guinea if the burial party does not provide its own cleric. The ashes can either be buried in the grounds at a fee of one guinea, or preserved in the chapel of the crematorium, or they may be taken away. Two medical certificates are required to show cause of death, and one, at least, of the doctors giving such a certificate must have attended the deceased in the usual manner; it must also be stated that the deceased had expressed no wish contrary to the carrying out of this form of burial. It usually takes about an hour and a half to cremate the body, and the process must be performed three days after death if the death took place in London, or four days in the country. Anyone interested may attend at Woking and see over the place, provided no cremating is taking place.

A DAMP EXTRACTOR.

The most serious drawback to the English climate is damp. A humid atmosphere imports unwelcome moisture into our homes—not always to be driven out by a roaring fire in the grate—and jerry buildings—no matter how well aired—are only too often little better than strainers for the copious rainfalls that naturally inundate our over-populated centres. Many of the ills to which flesh is heir, come to us through the medium of damp rooms, damp beds, clothing, etc. For this reason we cannot but welcome an invention whose object is to mitigate and even obviate the danger. The preparation to which we refer is known as "Seteriat," which has a peculiarity for extracting damp from any room or any object. Therefore, apart from ordinary household purposes, its hygroscopic qualities will be found of great utility in the laundry. "Seteriat" is, we understand, prepared by Messrs. Flower and Co,. of York-street, Liverpool.

THE body of every spider contains four little masses pierced with a multitude of holes, imperceptible to the naked eye, each hole permitting the passage of a single thread; all the threads, to the number of one thousand to each mass, join together when they come out, and make the single thread with which the spider spins his web, so that what we call a spider's thread consists of more than four four thousand threads united.

If you have an idea for a patent, write to the Editor of SCIENCE SIFTINGS, giving the outline of your scheme. The communication will be treated confidentially, and an expert will give you the fulles nformation as to the manner in which to proceed.

SOCIAL SCIENCE.

LIVING FOR EVER.

Our conviction is, after a good deal of observation, that most people do not care for life. They desire perpetual youth only as a capacity for perpetual indulgence; but if you take away the impossible idea of eternal youth they have no choice for life. We mean by this that when the question lies between habits that waste and destroy, and habits that preserve and continue, the majority deliberately choose the former. But clearly, in any discussion of the perpetuity of personal existence, we must at once drop any thought of fixedness at any one point of our career. Not for a moment can living be mere living without going ahead. It is not so much because time carries us forward as because living is a process. This process means change. It is possible at all only by a total readjustment of every cell at each moment. This we can see of a tree, that the moment it ceases growth it begins irrevocable decay. It is precisely the same with all animal life. Our position as intelligences also involves continuous development or decay. Clearly our sensations cannot stop; if not, then our experience must increase.

That is what it all comes to. Youth must follow childhood, maturity youth. The real question of interest is, whether we cannot continue development a great deal longer in the present life and under present conditions—in fact, whether it is not possible for us to go ahead with a steady, safe progress in this body, for an indefinite period of years, without coming to a point where growth is no longer possible and where decay must set in. We suppose anatomists would be very prompt to assure us that the body is sure to get to the end of the first stage of development by about 20 years of age. That by 40 or 45 it has inevitably reached another sort of completeness; by 65 or 70 has reached a necessary beginning of decay, and that by 100 it must return finally to the elements of which it is composed.

We do not yield this point at all; indeed, we do not believe that the power of mind over matter in this direction is fairly tested. Only just now we do not care to fully discuss this point. We may not, however, pass by the fundamental fact that life organisms of the lowest sort are very temporary and that as we climb higher organic continuity vastly increases. That means that the development of sensational and intellectual conditions reacts on the physical framework. And we know farther that our methods of thinking and feeling certainly have a vast deal to do with not only health but life. So the question is, "Why cannot we so think and will as to live a very great deal longer—possibly for ever?"

Of course, we have directly before our faces the fact that other forms of life are only stages. For instance, the worm has his worm life only in order to get where he can become a butterfly. And the question is a fair one. How do we know that this life is not something of the same sort; something that lifts us up to a point where we can become something else, and better? Of course, if we yield this, or agree upon it, we have yielded the point about which we began to contend; that is, the possibility of indefinitely protracting the process of development that we are now in. If we are simply being lifted to get in reach of a greater style or broader phase of existence, we do not even wish seriously to protract the present phase beyond its needful limits. There is a good deal in favour of this theory. Not only do other creatures present such stages of development, but our own lives show periods of expansion. There is not enough account

taken of the great enlargements that occur two or three times in a normal career. Puberty is not a mere sexual change, but a whole newness and re-creation, of the individual. Between forty-five and fifty-five every honest soul goes through another development—a startling re-creation. So true is this that we often wonder at our friends, and say: "How curious! His sentiments and sympathies are so unlike what they were! He was narrow, wilful, bigoted; suddenly he has become enlarged." Every wholesome person becomes a new man beyond and after forty.

It will help us somewhat to find out if these, or similar periods of development, precede this life. Are we quite sure our present existence is our first? Are we *de novo* when borne into the air? All oriental religions believe in pre-existence of the soul. There are even people who think they can remember previous stages, to some extent. But this is very questionable; and it must be confessed that orientalism is purely speculation. But we do have a pre-existence that is demonstrable. In pre-natal life we go through the whole history of life evolution—all its stages of progress on this planet. To be sure this is done very hastily—and what nature worked out in many millions of years we rehearse in a few months. But this is enough to show us that our career reaches backward; that essentially we did live in the first human being—and a good deal before that. It is really impossible to reach a point where we lose ourselves. What this means to us is, that not only our dust, but our organism and the vitality of it, and to some extent the purport of it, is not a novelty, but an antiquity. Of course, our past is hedged in, and difficult to apprehend; quite as much so as our future.

What we wanted to see in these facts was and is this—that really we cannot find a place where we quite get out of the life current, and so our present career fits in as a probable partial life, and not as a whole one. Let this be borne in mind, yet most of us do not wish to get hastily through the present period of our evolution, and we revert cheerfully to the question whether we cannot greatly protract our existence in its present stages. The accepted allotment of three score and ten years has already been considerably extended. The average of human life is also pushed up steadily, and has been actually doubled inside the past two centuries. This is a sterling achievement of mind over matter. In the main it is due to the determined purpose of civilisation and of science to ameliorate human conditions and fight down the foes to health and life. We have done a vast deal of conquering in this way, and nothing that man has ever done has been so bravely and masterfully done as the invasion of the realm of the infinitesimal and the overthrow of the causes of malignant diseases. We are not at the end of this work. We have gone so far that we no longer confess a single disease to be incurable or unpreventable.

What are the causes, now most common, of abbreviated lives? The general difficulty is a lack of definite purpose. It is taken for granted that we have to die, and there is but a feeble impression that we have much to say about it. There is a large degree of fatalism in our blood. We have inherited the old semi-barbaric measure of 70 as the natural limit of life, and do not question its present applicability. So far there are only sporadic efforts to establish 100 as a more reasonable life-measure. But during the coming century, at the present rate of progress, 100 will be reached as often as 70 was in the year 1850. Faith-curists certainly do no great harm; but they fail of a full comprehension of the problem. We shall reach a state of such mental supremacy that we can say to disease and death, "Begone"; but we are finding out our power to master the conditions of disease. The feeling of power is half the battle.

You will observe that fruitage or seedage is in a plant excessively exhausting. When an ordinary plant goes to seed it begins to die. To propagate is to give way to other individuals. But immortality is an aim at reversing this process. It clearly stands, at the very outset, as a reasonable demand that we shall not wait until twenty or thirty to begin the lengthening and strengthening effort, but must begin at the very outset. Our social laws should aim at protracting infancy, and then at protracting childhood. We wish to delay ripening, so far as we possibly can. We find that the short-lived races are very quick to mature; they marry at ten or twelve, other races at fourteen to sixteen. Our work has been to push out childhood as far as eighteen or twenty. This drift is, or may be, increased.

There is no physiological reason why puberty shall not invariably be beyond eighteen. The street arabs are mentally and physically ahead of average children. But their faces bear old-age lines at fifteen, and they are dried up at twenty, while few of them live beyond thirty or forty. On this basis we argue that a reasonable delay of marriage is wholesome; that wedded life, as a rule, is sounder physiologically if consummated at thirty than at twenty. We are considering now only the one object of prolonging our own lives, and subordinate to that the prolongation of infancy and childhood. A good deal may also be done in the way of cultivating a youthful sentiment quite into years, in fact refusing to grow old.

It seems clear that age is at a disadvantage with youth, not only because of mere oldness, but far more because of anxiety. The head of a family has assumed responsibilities that he cannot carry without serious and continuous danger. There is a sharp demarcating line between youth and manhood that makes the latter suddenly more wearing. The question is a fair one, if we have not made a vital error in our judgment of what an honourable and successful life should involve. Thoreau was convinced that we had, and he took to the woods. But that was rushing from one extreme to another. We need not go back to barbarism or wild life. We can, however, unload our civilisation of half its burdens—perhaps more than that. Our houses are pretentious, our furnishings are half shams. Human lives are worn down by the mere keeping up of our establishments. Every home should be exactly that, and involve exactly that which will develop health, and no more. Play and recuperation are as legitimate duties as work. Worse, however, than the home is the office and shop. These are so linked with the idea of success in life that they become intensely competitive. Trade implies getting "ahead" in the world. Social rank stands behind and urges on the over-anxious husband and father. Education of children is becoming a horrible burden, whereas it should be, and ultimately will be, a matter of trifling expense. In such ways the parents are worn down at 40, are old at 50, and decayed, if alive, at 60.

Under civilisation at least, and in the higher walks of society, life is also liable to snap from an overstrain. It has come to be a very special duty to refuse to involve ourselves in tasks that use up our vital energy, and to engage in business that does not admit of easy recuperation. This would be heartless talk if it really referred to what we falsely call "our labouring classes." This term labourer should be applied more strictly to men and women who use particularly and live by the use of the brain or nerves. These people

suffer infinitely more than those who do hand-work—even if the latter are overtaxed and underfed and underpaid. No estimate of the social problem will be final that does not consider this. Those who drop dead are, for the most part, men and women of brainy tendencies.

The Index to Volume I.

may be obtained on application to the Publishers, price 2d., post free, 2½d.

Covers for binding Vol I, price 1s., post free, 1s. 2d.

Or through any Newsagent.

HELPFUL HINTS.

This column is intended to help our readers, by answering reasonable questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

Conscienscious Testimonials.

L. A. Lancaster.—There is a common belief that only a fool or rogue would permit the publication of his name in support of a fraudulent and disreputable traffic. Every rule has, however, its exceptions, and we would suggest that in the case of the eminent athlete you mention some real benefit has (although doubtless merely by coincidence) accrued. You might read what we have to say on this subject under "Science News and Notes." As to your other question "Why do things touch?"—we can only reply, in the Hibernian style, "How do you know that they touch?" Many distinguished philosophers are of the opinion that, as the ultimate particles or atoms of bodies are *very closely* approximated, their mutually repulsive force increases, practically without limit, and that, as a matter of fact, these minute particles never come into contact with one another.

Sound and Motion.

Mighty Inquisitive.—The reason why the whistle of a locomotive seems to alter in pitch as the train passes is that the pitch of any sound is determined by the number of ærial pulses or sound waves that impinge upon the organ of hearing in a second. As the train approaches, these pulses, travelling towards the observer, are crowded together so that their frequency is increased. On the other hand, the effect of the recession of the train, after it has passed the observer, is to draw out and, therefore, diminish the frequency of the waves of atmospheric disturbance constituting sound.

What is Gravitation.

E. Kennedy.—We cannot possibly agree with your suggestion that the science of astronomy is built upon merely suppositious premises. Your question "What is gravity?" is a poser. But to your other question, "Is electricity gravitation?" we can give a decidedly negative answer. A moment's reflection will convince you that (say) a one pound weight gravitates to the earth while at the same time they may both be at one identical electrical potential. Would that it were otherwise, for in that case ærial navigation might be very readily achieved. Do not imagine that Siftings is wedded to what you call scientific orthodoxy. We subscribe to the dictum "prove all things," and receive with pleasure any novel and interesting speculations. But we cannot publish what bears the impress of falsity upon the face of it.

Cookery in Mountain Districts.

P. Osborn.—In order to heat water to the normal temperature of boiling, under diminished atmospheric pressure, as at the top of a high mountain, you should employ what is called a Papin's digester in which may be placed any articles of food that you may wish to cook. The weighted safety valve or escape of the digester causes increased pressure, and, therefore, increased temperature of the boiling fluid in its interior.

Electric Belt Advertisements in "Science Siftings."

Querist.—We are aware that loose advertisements of electric quack appliances have been insetted in Science Siftings, our attention having been drawn to the fact by hundreds of readers. We distinctly repudiate any responsibility for this, the advertisements having been inserted by wholesale newsagents and others, after the papers have left our hands.

How to Write.

P. R. S.—We do not believe there is any hand-book that will enable you to improve your writing. It is already very good, aud practice will perfect it. To obtain a quick and flowing hand, dash off long wavy and angular lines, without attempting to form letters. This will give great freedom to the hand.

Miscellaneous.

Wm. Wright.—Thanks for your appreciative comments. We have forwarded Nos. 1 and 2 to you by post. You will find that in every newspaper reports occasionally gain admission of which the accuracy is not subsequently confirmed. We are generally very successful with our "sifting," however, and when, as a matter of novelty and interest, anything not incontestably accurate is published, this is with due reservation, and, as it were, under protest, for the better elucidation of matters as yet *sub judice*. As to the instances cited by you we may say: (1) That you have probably neglected to allow for the atmospheric moisture inspired into the lungs. (2) The paragraph referring to the colours of flowers cannot be found. At least we have devoted half an hour to looking for it without success. As a general rule, we cannot undertake to deal with such references unless number and page are specified by the querist. (3) If you draw a sectional diagram showing the curve of the boundary of the atmosphere and the position of the sun and the observer, you will find that lines drawn to the eye from the upper and lower edge of the sun's disc make somewhat different angles with the curve referred to, and that, in accordance with the requirements of theory, the effect of this is to modify the apparent angular dimension of the sun.

C. Bullock.—Quite right. "Pulsating artery" would have been better than "pulsating vein" in the reply to query 202. We believe, however, that the sphygmograph is sufficiently delicate in its action to give an equally accurate record of the feeble pulsations in a vein as of those in an artery.

W. H. T.—Stones do not grow. On the contrary, they are worn away by attrition, and by "weathering," and so gradually rounded and reduced in size.

H. M. Beck.—Thanks for observations *re* discovery of Ark. You are referred to our reply to Mr. H. Botomworth, in our issue of 17th ulto.

W. S. Scriven.—Thanks for suggestion and for your good wishes. All the back numbers of Science Siftings can be had through any newsagent or direct from the office of publication. As to the advertisement, you do not say whether it is to be inserted in our "Sale and Exchange."

H. Stream, Charles Smith, and D. J.—Many thanks for your interesting letters on the subject of our change of title. The decisive step has now been taken in this matter, although not in the direction that you have suggested. We infer from the tenor of your remarks, however, that you are to be counted among the regular readers of Siftings.

V. B.—The announcement made on page 309 is a sufficient reply to your interesting letter.

Geo. H. Ryan.—The eyepiece of any telescope is virtually a microscope employed to enlarge the real image formed by the object glass. Your book is reviewed on page 331.

Chadwick, B. B. Co.—We must apologise for not having dealt with your belt before this, but we have been simply inundated with electric appliances for testing purposes. We have now tested your belt, and while we find it generates a useful current of electricity, we cannot from experience speak of its efficiency as a medical appliance.

——(*Re* medical science and massage.)—You have evidently omitted to sign your communication. Send your name and address when we will reply to you.

J. Nicholson.—Extremely obliged for your communication. Induce all your friends who have been defrauded by any electric-belt quack to write to us. We are utilising all this evidence, in what manner will appear later on.

A. C. Ellis.—As you say, "different people have different ideas." We wish they had not. It is our endeavour to please all, that has caused us to change the title.

A Well-wisher of Science Siftings.—For the present we are compelled to be silent.

A. King.—Many thanks for your action. It may help us materially.

Charles H. Ward.—The date given was quite correct. It was only an incidental note in a column article on Mr. Bryce's career headed "Our Public Men."

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

[Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of* 6*s.* 6*d.* 6 *months,* 3*s.* 4*d.,* 3 *months,* 1*s.* 9*d.*

Advertisement Offices: 167, & 168, Fleet Street, E.C.

'Sale and Exchange" Advertisement Offices: 78, Fleet-street, E.C

Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, OCTOBER 8, 1892.

NOTICE.

On and after Oct. 22nd, commencing with No. 53, Vol. III., the Title of this Paper will be changed to:

SIFTINGS.

The Tit-Bits of Current Thought

on

Health, Science, Food, Invention, Literature, and Sociology,

ELECTRIC BELTS.

The Electropathic and Zander Institute has taken proceedings for libel against this Paper. The matter in question is, no doubt, well within the recollection of our readers, and, of course, we have no desire to comment pendente lite. *However, we shall be pleased to receive, in confidence, particulars of any* bona fide *complaints bearing on the details set forth in our articles. Our readers will thus be assisting the good cause.*

SCIENCE NEWS AND NOTES.

"Like a morning dream, life becomes brighter the longer we live, and the reason of everything becomes more clear. What has puzzled us before seems less mysterious, and the crooked paths look straighter as we approach the end."—JEAN PAUL RICHTER.

Poverty of the Blood,

as shown by paleness, thinness of body, weakness, and nervousness, is a complaint from which the inhabitants of a densely crowded and competitive city like London suffer of a necessity. The medical term for the complaint is anæmia, and in extreme cases the sufferer will be found with pallid lips and colourless tongue. The cure is common sense and will, in equal parts. In olden times iron was almost wholly relied upon to overcome anæmia, and at the present day this is the one remedy to which patients suffering from it resort to when they undertake to treat themselves. But physicians, while giving it in many cases, depend far more upon simpler and more effectual measures. These are dietetic and hygienic. They insist upon free exercise, and that several hours be spent in the open air, either walking or riding, each day. Also at such times that the so-called "breathing exercise" be frequently employed. In the simplest form of this the subject, while standing with shoulders thrown back, inflates the lungs to the fullest extent, the mouth the meanwhile being closed, and the air entering only through the nose. Of all measures this is one of the most important, for by the means of it the blood is purified and vitalised.

Plenty of Friction

administered with a wet flesh glove or towel or by sponging the body with water that has been made comfortably warm, the operation to be followed by vigorous rubbing with an ordinary towel, is another measure of no little importance, for by it the waste avenues in the skin are kept well open, and, besides, a general tonic effect is secured. Disregard this or other as efficient means for promoting cleanliness, and the blood can never be perfectly pure, for it sure to take up and carry with it some of the waste matters that should have been expelled through the pores of the skin. The clothing must be carefully looked to by this class of patients, while in winter "bundling up" is not to be encouraged, yet the clothing should be ample, and that worn next to the skin be of all wool. "Jaeger" is good, but very expensive, and as a matter of fact any other make of pure wool has as good an effect, while it costs less. As regards the diet, it should be as highly nutritious as the digestive organs will warrant, and should consist largely of milk, fresh eggs, and beef steak. If all these measures are faithfully applied, infinitely much will be done towards restoring the blood and renewing the strength of the system. And if at the same time small doses of iron are taken, the gain from week to week ought to be noticeable. But from this remedy alone very little can be expected.

In this Rheumatic Climate

it is not surprising that a considerable proportion of our readers should suffer from the complaint, with the result that we are inundated with requests for a cure. "Fools rush in where angels fear to tread," and we must, therefore, inform our questioners that we know of no cure for every description of rheumatism, as many severe cases can only be alleviated or cured by the untiring, watchful care of a medical man. But ordinary rheumatic pains in the joints and other portions of the body may be remedied by heat. Flannel cloths dipped in very hot water and wrung as dry as possible should be applied to the parts, and the whole enveloped in a thick, dry flannel cloth to retain the heat. The application should be renewed every five or ten minutes. The application of ground mustard in the proportion of a tablespoonful to the quart of water, increases the effect of the heat. A teaspoonful of turpentine sprinkled upon the fomentation just before it is applied, or a cloth saturated with a solution of one part turpentine to two or three of alcohol, applied over the affected part and covered by the fomentation, is also a means of intensifying the effect of the

fomentation. The various liniments used for rheumatism have little or no curative value, although some are useful for the relief of pain. One of the best is a simple preparation consisting of equal parts of olive oil and oil of wintergreen. It should be applied carefully, however, as the pure oil of wintergreen is quite a vigorous irritant. Menthol liniment is also a useful application.

The Evils of Cycling

to which we recently referred brought upon us and the *Lancet* quite a storm of abuse from ardent votaries of that sport, who, like too-ardent votaries of anything else, only open their eyes to the merits of the case. However, cycling has its good as well as its bad side, and the good undoubtedly outweighs the evil. Our object in our previous paragraphs was not to damn but to make more fair, by opening these same wilfully closed eyes, so that a broader view might be taken and danger averted. What we preached was moderation as opposed to excess. Since we cannot import good air into our cities, we must export our cities into good air, and this is exactly what cycling does. It has given wings to an animal whose physique was deteriorating because its wants were not supplied, and enabled it to cheaply and conveniently supply them. It brings into play muscles which, being long idle, add only weight to the body and become the storehouses of dead products—rusts which the eliminating organs have to dispose of by one or two channels alone, which after a time are overtaxed and deranged in function.

The Mind is Benefited as well as the Body,

since the mind not less than the body pines under the penalty of home imprisonment. It must have freedom if it is to develop and become sound and good. Let it rest day after day all through life, feeding on the same fare; let its eyes rest upon the same pictures, its ears receive the same grinding sounds, its nostrils absorb the same persistent odours, and how can it become anything more than a cribbed, wearied, discontented, and dwarfed mind. The mind of the youth buried in the confined community was of this kind. It knew no expansion, felt no elasticity; became timorous, obstinate, feeble. Cycling has changed these conditions as if by a magic spell, with the result that the exercise of cycling has become a prescription with the physician, and in many cases, the *Lancet* points out, those of melancholic dyspepsia especially, a prescription of great value. Our wish is that every good result from cycling, physical or mental, may be obtained by the exercise. It is only when we see it perverted and strained, when we see it becoming physically a cause of organic evil, that we venture to tender our admonitions. The evils it has called forth have been physical evils, affecting that vital mechanism which it is the duty of the medical profession to study and comment upon. Hence surely even the most enthusiastic cyclist will allow that the *Lancet* or SCIENCE SIFTINGS needs no excuse for pointing out and strongly deprecating evils which our knowledge and experience have shown us to undoubtedly exist.

The Physiology of Blushing

was amply defined in these columns some little time since, in reply to a correspondent. We have also been asked what is bashfulness, which is, of course, the prime motor of the first-named complaint. Now, the quality of modesty has in all times commanded the respect of thoughtful and sincere persons. In it we recognise one of the most familiar marks of a genuine character, and we should be very doubtful if, other things being equal, it has ever really stood in the way of its possessor's advantage. Where it has appeared to do so we may safely say that it has been represented by some spurious imitation, or if present, has been associated with personal failings which ought really to bear the blame too lightly attributed to its operation. Of its imitators we may select one as an example—bashfulness. So closely do these two qualities approach one another at certain points that the distinction between them is almost lost sight of. Yet there exists essential points of difference which have been ably described by the *Lancet*. Both agree in avoiding prominence, but in the case of the former this is due to a humble estimate of personal capacity and an unselfish preference of others, and it is compatible with the free expenditure of effort when occasion demands this. With bashfulness it is different. Self-consciousness is here the commanding influence, and this is by no means a necessary counterpart of self-abasement.

Want of Acquaintance with Existing Social Conditions

is allowed to assume an exaggerated importance. There is a disinclination to abandon a resulting attitude of habitual reserve which even the claims of mutual duty which bind together members of the social whole are unable to overcome. We do not forget that a neurotic basis often underlies this inveterate shyness. The blush, the changing expression, and a variety of like indications, as our medical contemporary has pointed out, clearly denote this. There is doubtless a mental hyperæsthesia which is congenital and, therefore, the less amenable to treatment. Even this, however, is but a functional condition, and, therefore, not incurable. What is required for its relief is the steady exercise of a dominant control acting through nerve centres at the instance of the will. No good is done by closely contemplating the disorder, but the cure follows most surely when personal peculiarities are ignored, and when even identity is sunk in a sense of dutiful relationship with others. A habit of concentration upon work and the cultivation of free social intercourse constitute the most obvious aids of the will-power in this matter.

A Placid Temperament

is undoubtedly the secret of a prolonged and healthy life. An excitable and panical constitution has the reverse effect. It is therefore, eminently desirable for individuals to be careful to cultivate the faculty of self-control, which, as Herbert Spencer has said, is the chief distinction between the human being and the brute. Panic is, in short, neither more nor less than a maniacal excitement with, among other symptoms of derangement, loss of appetite, watchful and sleepless nights, and a total incapacity to think soberly on any subject, the whole mind being absorbed by the one idea which swamps all its ordinary activities and diverts them from a normal, healthful flow into an insane rush of selfish impetuosity. The evils are not finished when the panic has been lulled by the evidence of stability and safety. The injurious effects upon individuals are not easily surmounted, and, as a writer in the *Lancet* claims, the serious evils of the resulting nervous exhaustion and prostration of recent panics are now beginning to make themselves felt among those directly or indirectly concerned in the foolish and needless excitement. The full and ultimate chronicle of such panics is written in the case-books of our lunatic asylums; and although we are well aware of the futility of advice in dealing with actual panic, we nevertheless feel it to be our duty to issue a note of warning on the subject, and to impress upon all the great necessity of cultivating and exercising in every walk of life and under every circum-

stance in life the all-important moral attributes of self-control, self-restraint, self-government.

Thirst-Quenching

appears to be, in the double sense, an absorbing topic with our readers. We recently stated that potass was the best thirst-quencher known to science. We are now invited to say how it may be used. The object served by potass is to set the salivary glands excreting freely, and this will be effected by placing a little dry nitrate of potass in the mouth, which will stir up the nerves that govern the supply vessels. But the nitrate of potass is much more palatable if dissolved in water and flavoured in any way that may seem good, but the flavouring matter must not be of such a nature as to render the action of the potass nugatory. An addition of the carbonate of potass or bicarbonate of soda assists the solution of albumen which is the object aimed at, although acids, heating substances, common salt, and other things that occasionally find their way into aërated beverages, are not thirst-quenchers at all, or only so far as the water is concerned, the other ingredients serving to hinder the solution of hardened or glairy albumen. Possibly, however, thirst may be quenched for the moment in this way, because by removing the protective layers and hard albumen with an acid, the next layer of the epithelium is made to give up some of its moisture. Even nitrate of potash, however, must be used in moderation.

The Influence of Steam Upon Magnets

has been made the subject of some interesting and really important investigations by a German chemist. It was found on heating them for some time in steam that they lost from 28 to 67 per cent. of their power, and if they were then remagnetised and again subjected to the action of steam there was a very slight loss of power. From the result of these experiments it was concluded that after such treatment the magnets would be less liable to deteriorate from mechanical vibrations as well as heat. Upon testing this theory it was found to be borne out by the facts. After treating a magnet with steam for four hours, and then remagnetising, it was subjected to fifty blows, both transversely and longitudinally; upon testing the magnet, there was but a slight loss of magnetism, and repeated blows failed to increase the loss to any considerable extent. In view of the showing made by these experiments it is claimed that repeated steaming and remagnetising are the best means of securing permanent magnetism in hard steel.

The Fate of the Human Body

or even ships that are lost at sea, appears to be a matter of uncertainty with many, who believe that on acount of the density of the waters at a great depth, they remain suspended at some distance above the surface of the earth. This is an error. No other fate awaits the drowned sailor or his ship than that which comes to the marine creatures that die on the bottom of the sea, and those who have investigated the matter, show that in time their dust all passes into the great storehouse of the earth, even as those who receive burial on land. However deep the sea, it is but a few hours before the body of a man who finds his grave in the ocean is at rest upon the bottom; it there receives the same swift service from the agents which, in the order of nature, are appointed to care for the dead, as comes to those who are reverently inhumed in blessed ground. All save the hardest parts of the skeleton are quickly taken again into the realm of the living, and even those more resisting portions of the body in time are, in large part, appropriated by the creatures of the sea floor, so that before the dust returns in the accumulating water to the firm, set earth, it may pass through an extended cycle of living forms.

The Intelligence of Spiders

in the application of means to gain a desired end sometimes seems to indicate the possession of acute reasoning powers. Not long ago a correspondent noticed a large spider on a stick about 2 feet long, and while idly sitting on the bank of the stream, he picked up the stick to watch the insect, and then, without any definite idea of what would happen, he planted the stick in the mud, about a yard from the bank and watched to see what the spider would do. The little insect ran down the stick as far as the water, then retreated; up and down it went, half a dozen times until apparently satisfied there was no way of escape. It then took up a position at the top of the stick and paused, when, to the amazement of our correspondent, he noticed a tiny silken thread floating away from the little creature through the air. The breeze was blowing towards the shore, and in no great length of time the thread had caught on some blades of grass. Then the spider tried to draw it in, but it held fast. This was just what he wanted, but, afraid to trust his whole weight on the slender filament, he tested it first with one foot, then with another, holding tightly to the stick meantime for fear of accident. At last he seemed satisfied that his bridge was secure, scrambled over it to terra firma, and vanished in the grass. No human being could have acted with more judgment and discretion, and the tiny insect showed a degree of ingenuity that seems incredible.

A Similar Intelligence

is shown by the butterfly. Mr. G. Lyell, of South Melbourne, says that he was one hot day walking by a small river, when he saw a butterfly alight close to the water, into which it backed, till the whole body and the lower part of the hind wings were submerged, and two of the four legs alone retained their hold of the dry land. After remaining in this position for about half a minute, it flew away, apparently refreshed. During the morning, numbers did the same thing: in one instance, no less than four were to be seen within a space of three yards; and to make sure that his suspicions were right, Mr. Lyell captured several as they rose from the water, and found in each case that the lower part of the body and hind wings were wet. While in the water the fluttering of the wings, so noticeable a feature at other times, was suspended; and so intent were the butterflies on the enjoyment of their bath, that they would hardly move, even when actually touched by the hand. Apparently the hot weather drove them down to the water, as immediately they emerged they flew up again to the hill-side.

LATE calculations show that the waves of the sea have wonderful force. On the shores of the Shetland Islands it is not at all unusual for gneiss boulders weighing upwards of three tons to be moved 300 feet in a single night. At a placed called Bishop's Rock, an iron column 25 feet long and weighing 6,000 pounds—part of a light-house being erected on the rock, and which had been chained by means of eyebolts to two heavy boulders—was moved 20 feet in one night and deposited upon a projecting rock 11 feet and 10 inches higher than its original position. At the same time a blacksmith's anvil weighing 200 pounds and sunk in a pit 3 feet and 6 inches deep, was washed out of the pit and actually floated and rolled 100 yards from the site of the light-house.

GLEANINGS OF THE GLOBE.

ALCOHOL was discovered in the thirteenth century.

THE thermometer was the invention of Galileo, in 1596.

GUN caps were first used in 1822 in the English army.

STEMWINDING watches were invented by Noel in 1851.

ANILINE dyes were discovered by Unverdorlen in 1826.

A WORKING steam engine was invented by Papin in 1681.

SAVERY, in 1698, built an engine to drive a mine pump.

THE Marquis of Worcester, in 1663, built an engine to run by steam.

WATER was decomposed by Cavendish by means of the electric spark in 1787.

MILNER'S electrometer was invented in 1783; a similar device was invented by Peltier.

A GOLD leaf electrometer was invented by Bennett in 1789 and subsequently improved.

MME. GALVANI noticed the movements of frogs' muscles in contact with metals in 1789.

THE first galvanic battery was constructed by Galvani, in 1791, after many experiments.

A FRENCH physician of the beginning of this century, Napoleon Savart, was the discoverer of the phenomenon called interference of sound. If the ear is placed at a short distance off a sounding or echoing plate and gradually drawn away, it will be observed that the sound alternately dies away and comes back with twofold intensity. The explanation of this is that the waves of sound, the direct and reflex waves, alternately neutralise and reinforce each other.

A VERY useful little journal, avowedly devoted to natural living, physical culture, health reform, etc., is entitled *The Hygienic Adviser*. It is published monthly at one penny, or 1s. 6d. per annum, post free. The contents of the number before us, comprise: Notes on Swimming—Evolution and Physical Development—Fruit and Sickness—Lewis Cornaro, the Centenarian—How I Spent my Holidays—List of Prize Winners—Mutual Aid Column—Free Health Advice Column—Trades Directory, etc., etc. The publisher is John Heywood, London and Manchester.

THE ancestor of the large and fleshy cabbage was a veritable pigmy—a small plant weighing altogether scarcely half an ounce. A diminutive little vegetable, reddish in colour and bitter in taste, has been metamorphosed into the inestimable potato. The sweet, juicy Altringham carrot, weighing from 5 to 6 pounds, is in a wild condition a dry, slender root unfit to eat. The delicate, well-flavoured Vienna glass cauli rapi, as large as a man's fist, is when wild a slender, woody, dry stem. The cauliflower in its natural locality is a thin branched flowering stem, with the little green, bitter flower buds.

MORLAND, in 1683, built steam engines for mines.

EVERY year there must be two eclipses of the sun, and there may be five. These are partial eclipses, however, except in the comparatively rare case in which the moon passes nearly centrally over the sun's disc and produces a total obscuration of his light. Since the invention of the spectroscope in 1860 there have been barely a score of total eclipses, and a number of these could not be observed because the belt of totality fell at the earth's polar regions or upon the oceans. The belt of totality is a narrow strip—never more than 170 miles wide—where the point of the moon's shadow falls upon the earth. Total eclipses rarely recur, therefore, at the same point of the earth. In London, for example, there has been no total eclipse since the year 1140 except that of 1715, and there will be none during the next century.

A VERY ingenious mean-time sun dial has been invented by Major-General J. R. Oliver, C.M.S., and is supplied by Messrs. Negretti & Zambra, Opticians. The gnomon, instead of having a straight edge as usual, is of a curved outline whereby with the variations in the sun's altitude the same effect is produced as if the edge of the gnomon were moved along this curve. Thus the "equation of time," amounting sometimes to more than 16 minutes, is practically eliminated, and the sun dial is brought into accordance with the mean-time clock. Although the invention is little more than a scientific toy, so far as England is concerned, it is believed that it will be of great use in countries where sunshine is plentiful and means of regulating the time are scarce. South Africa, South America, Australia, and India may be adduced as instances. In India, for example, there are numerous up-country stations at a distance from any railway, where there are practically no means of correcting clocks and watches.

THE programme for the forthcoming season of the Upper Norwood Literary and Scientific Society is most excellent. The following is a syllabus of lectures:—Oct. 6—"The Habits of Ants." The Right Hon. Sir John Lubbock, F.R.S., M.P., D.C.L., L.T.D. Oct. 19—"Darwin and Later Theories of Evolution." Professor Patrick Geddes. Nov. 2—"G. Meredith, Novelist and Poet." A. Conan Doyle, M.D., Nov. 16—"Wild Animals in Captivity, and Domestic Animals." Gambier Bolton, F.Z.S., F.R.G.S., etc. Nov. 30—"The Science and Art of Music and a History of its Progress in England"; with illustrations. W. H. Cummings, F.S.A. Dec. 14—"Here, There, and Everywhere: My Baptism of Fire; Bulgaria; Afghanistan; Turko-Servian War; Burmah; Egypt, etc. Frederick Villiers, F.R.G.S. Jan. 4 (1893)—"Psychical Research Society: What are its aims and what results have been attained?" Professor W. F. Barrett, F.R.S.E., M.R.I.A. Jan. 25—"The Story of my Life." Felix Volkhovsky. Feb. 8—"Henrik Ibsen." Edmund Gosse, M.A. Feb. 22—"Curiosities of Bird Life." R. Bowdler Sharpe, L.L.D., F.L.S., F.Z.S. Mar. 8—"An Indian Village." H. G. Keene, M.A. Oxon., C.I.E., Fell.U.C. Mar. 31—"Curiosities of Brain Action, as illustrated by Dreams, Mesmerism, and Ghost-seeing, fully illustrated by Limelight, etc." Dr. Andrew Wilson, F.R.S.E., F.L.S., etc. The lectures will be held at the Royal Normal College at 8.15.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not satisfactorily replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 49.

217.—Why is it desirable, when writing, to allow the light to fall over the left shoulder?

It is best that the light should be allowed to fall over the shoulder because in this way the paper may be brightly illuminated while at the same time the eyes are screened from the irritation and, indeed, injury caused by the glare of the lamp. The reason why the left side is selected is simply in order to avoid the shadow of hand and pen upon the writing.

218.—What is the advantage of mercury over every other liquid for barometers and thermometers?

Instruments containing mercury can be used throughout a very great range of temperature, and one extending well above the temperatures with which we most frequently have to deal, where alcohol would be useless. By forcing a gas, such as nitrogen, into the tube of a mercurial thermometer so that the pressure of the gas prevents the mercury from boiling, it is possible to measure the intensity of heat with such thermometers even up to the point at which the glass from which they are made begins to soften. Then mercury does not "wet" the sides of a glass tube as so many liquids do, with the result that the quantity of those liquids contained in a column undergoing contraction is constantly varying. Mercury, being a good conductor of heat, is not very subject to local differences of temperature. Having a low specific heat, mercurial thermometers do not abstract much caloric from the substance whose temperature is to be tested, and they respond with rapidity to variations of that temperature. At ordinary temperatures the expansion of mercury by heat is extremely regular. The great advantage of using mercury for barometric purposes, results, of course, from its specific weight. The column of only 30 inches of mercury counterbalance the weight of the atmosphere equivalent to 5 miles of air.

219.—What is the venom of a snake?

It is a glairy, colourless, viscid liquid, almost neutral in reaction. Although a neurotic poison—a fact established by its action on the nervous system—it possesses local irritant properties, for when applied to the mucous membrane of the eye it causes violent inflammation. By simple contact it destroys the irritability of the voluntary muscles, and as it is injected by serpents it has a septic effect, inducing general blood poisoning accompanied by a tendency on the part of the muscles to undergo rapid decomposition. It is subject to elimination by the kidneys, mammary and salivary glands.

220.—Is there any difference between the teeth and bones of the body?

Bones consist essentially of ossein—a peculiar albumenoid—and the other matters which are found occurring in or with bones, such as marrow, a little fat, vascular and fibrous threads, etc., are mere accessories to the tissue proper. Bone contains about 32 per cent. of water and cartilage (ossein), the remainder consisting of mineral salts, principally phosphate and carbonate of calcium. The roots and stumps of teeth are bones properly so called; but the exposed parts consist of dentine—a tubular structure in which the proportion of ossein is about 25 per cent. The dental cement and enamel are composed very largely of earthy phosphates.

221.—What is colour?

Colour is a distinction drawn involuntary by the mind between the effects of stimulation upon three sets of nerves terminating in the retina of the eye. According to which of these sets of nerves is stimulated—or in what proportions the two or three sets are stimulated—by any given ray of light is the "colour" assigned to that ray. White light is, of course, composed of a mixture of rays of all colours, and the only essential distinction between these components is in the frequency of the etherial vibration which each of them involves.

222.—Why does soda water counteract the effects of alcoholic liquors?

Carbonic acid gas, of which a considerable quantity is contained in solution and in suspension in fresh soda water, acts as a local anæsthetic. It reduces the irritation of the stomach caused by presence of alcohol, and thereby diminishes many of the unpleasant effects of alcoholic excess.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

229.—How can adulteration in sugar be detected?
230.—What is aluminium and what are its uses?
231.—What is the difference between an aneroid and a mercurial barometer?
232.—Why is it possible to see phosphorus in the dark and not any other object?
233.—Is it a fact that oysters possess the nourishment usually accredited to them?
234.—How can the fact of meat having been frozen be detected?

STERILISING MILK.

Milk is sterilised cheaply as follows:—Put it in a cleaned bottle, loosely cork with a clean new cork, and then place the bottle in a vessel of water and heat it slowly to the boiling point, this temperature being continued for forty-five minutes; then tightly cork the bottle and set it in a cool place until needed for use.

The nutrient properties of the milk are not destroyed, or even weakened by this process, but for some persons it is more easily digested and is more nourishing. The heat destroys the micro-organisms and if kept cool and well corked they do not begin their work again for some time. Milk as it comes from the cow is free from them, but by contact with the air they reach it at once and it soon begins to change.

If you have an idea for a patent, write to the Editor of SCIENCE SIFTINGS, giving the outline of your scheme. The communication will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

AN OVERDRAUGHT ON THE NERVOUS SYSTEM.

The nervous system is not independent of the remainder of the body, especially with regard to its nutrition, but it possesses a certain self-existence by which it is enabled to maintain itself above many disturbances of the body.

The nervous system, too, is governed by economic rules. All are originally endowed with a certain amount of nervous force, as it were, a capital which has been inherited from ancestors and parents, and with this capital each goes on through life. A man may augment and increase it, but he may also reduce and even exhaust it. He who spends more of of his nervous forces than what he receives is on the inclined plane which leads to exhaustion, and he who exhausts his nervous forces in a permanent manner is bankrupt, although he may be a millionaire in his bank account. There are many such bankrupts jogging along through the streets of our large cities. There are many silent disorders which one scarcely notices, and yet these disorders are apt to render a person profoundly unhappy.

Our nervous system consists of the brain and the spinal cord; the nerves are the conduits which connect our peripheric organs with the central part. The best representation of nervous force is formed by regarding it in the light of some tonic power. It resembles the penned-up vapour of a steam engine. After a man has enjoyed a good sleep there is another condition in his nervous system from that in which he went weary to bed. This fact of a tension being lost by work and being able to be regained by sleep is of paramount importance, and we proclaim sleep, without hesitation, the most important source of the revenue in the economy of the nervous system. Unfortunately, many persons, and primarily the youthful, view sleep as a necessary evil. But the simple fact that sleep always returns and even possesses the faculty of breaking the strongest will power is significant enough. It would be very unfortunate if sleep, like some prudish damsel, should, after the first offence, abandon us for ever.

Man, in his hunt for gain and enjoyment, has learned how to chase away sleep by artificial means. He avails himself of all possible tricks for the purpose of "prolonging" the hours of work and of pleasure. He takes coffee, tea, or nicotine, and woe to him who proceeds carelessly, for exhaustion is the infallible end. It is true in this stage he is not without remedy, provided he has the courage of confessing that he is bankrupt, providing he has the courage of going into liquidation and of limiting his expenses to a minimum; in this case he may still be saved. But men generally lack this courage. They recur to another system —they contract debts; they borrow force, in all appearance. By this they quiet their conscience, only to render the catastrophe even worse. They take to artificial soporifics morphine, chloral, uretan, etc. Sleep induced by these substances is not normal, has not the power of refunding the expenses which we have had, and we would caution all against using them.

Fortunately sleep is not the only means of augmenting the nervous forces. There is an intermediate stage between work and sleep; it is recreation. The division of labour which in our days is necessary in all business pursuits as well as in science, which more or less transforms everyone into a specialist, has for a consequence that not all organs of the body, not all nerves, are equally fatigued. Thus it is not necessary to rush right away from work to sleep; on the contrary, it is even better, after having worked intelligently, to allow an intermediate pause to intervene. The advantage of a gradual transition from work to sleep has been known long ago. Cicero says in his speech for the defence of the poet Archias, that poets deserved the highest appreciation, because in the poems resided the power of gently carrying the overworked spirit to its rest. We, too, should avail ourselves of this same remedy.

Recreation should be considered from a higher standpoint than is usual. Many a one who takes his vacation for a fortnight or a month fails to obtain the expected restoration. Why? Because the transition from activity to rest was too rapid. We all know how things are being managed. This and that have to be settled and finished, then we start and abandon ourselves to complete repose. But too soon the last vacation day arrives, we step in again and a mountain of work is waiting for us. This modern vacation system is insufficient.

There is a third source of increasing the capital which we possess; this source is exercise. Exercise is a marvellous institution in our organism. With each repetition a work becomes easier, and we attain finally a working possibility which we had never thought of. Work invigorates not only the muscles, but also the motary nerves and the higher nerves. Intellectual activity is capable of a high increase, yet exercise will be of benefit only by observing certain laws. The ancients knew that we should not proceed too rapidly in this respect. *Nulla dies sine linea* and *Nunquam otiosus* means "Not a day without some progress."

This constitutes a significant hint. Anyone who wishes to advance should at the same time pay attention to the curious sensation which Nature has given us as a signal, and which we should never pass—the sensation of fatigue. Fatigue appears later and later in consequence of exercise, and we are gradually enabled to perform work which a beginner is compelled to abandon after a short time. Exercise is the real foundation of man's educatability, and this faculty should be taken into account before everything in the education of our youth. In this connection we would call special attention to one point which is always lost sight of. Exercise should be applied less to the acquisition of knowledge than to certain activities.

We may exercise our memory and acquire knowledge, but this is entirely different from the notion that education and culture consist in filling mechanically a young brain with a certain sum of knowledge. Human knowledge is acquired from dictionaries and cyclopedias. But there are no dictionaries of capabilities. Whatsoever is acquired by exercise remains a property of our mental power. From the standpoint of a neurologist, the task of schools is not to cram people with knowledge, but rather to exercise their intellectual forces by applying them to the various subjects.

When we see some one make use of some gymnastic contrivance for the purpose of increasing his strength, we should not say he will never need it. The same holds good of intellectual education. In practical life we seldom need our Latin and Greek, but what remains is a certain power of reasoning, analytically, and synthetically. This consideration should not be lost sight of in education.

But under all circumstances the sensation of fatigue should be taken into account, and a young man who feels fatigued should be allowed recreation. Beware of advancing too rapidly, of overbending the bow! Let us follow the fundamental principle of training. It is impossible for us to exceed certain limits traced by nature. As soon as we pass them we resemble a machinist who would drive with

seventy-five or more atmospheres a machine constructed for ten atmospheres. An explosion may be the result. It is the same with the nervous system. The nerves may be suddenly struck with total exhaustion by overbending the bow.

How is it that in our times so many nervous diseases are being observed? Our ancestors kept awake whole nights and subjected themselves to great exertions. But they knew nothing of this long procession of nervous disorders from which we suffer. Has man changed? Has he become more inconsiderate? On the contrary! Many have to suffer this exhaustion of their nervous system without their fault, by the force of environments. It is the peculiar character of our epoch which induces it, the immense increase of population, the agglomeration of so many thousands in our large cities, the excessive traffic absolutely necessary to provide these human masses with the possibilities of life. The whole modern mode of living is accompanied by a constant expense of nervous force. Our relations with other men have at least been multiplied ten times in the last fifty years; every single individual is more drawn into contact with others than in former times. These circumstances which we are unable to change are the chief origin of the nervous disorders which afflict us nowadays.

Is there absolutely no remedy? There is a remedy. We could not and we should not subject traffic and our exterior life to arbitrary limitations, but we should follow the indications of the times, by rendering traffic more pleasant and easier, establish noiseless means of communication, do away with irritating emanations of vapour and smoke, and the like. Our optic nerves being protected by the iris against an excessive intensity of light, we should turn our attention to the serious dangers threatening our eyes from a lack of light. Our modern intellectual occupations are not supported by a sufficient quantity of light, and for this reason all efforts tending to an increase of illumination, as the introduction of electric lighting, should be favourably received. And let us erect better buildings for our school children, buildings with better air, more light, and such facilities for physical culture as the age demands.

BEARS LIKE HONEY.

We published a paragraph (page 312) about bears climbing telegraph poles in Norway. Mrs. Frances A. Collins writes to tell us that it has been found in India that bears are attracted by the humming noise of the wires, and attack the poles to get at the honey which they imagine the bees have secreted within the wood. Some such idea may be in the Norwegian bear's brain when he climbs the pole and tries to make himself master of the situation.

Of late years physiognomists have declared for straight and compact foreheads, rather than high ones. High ones are often confounded with foreheads merely bald; and baldness, whether natural or otherwise, is never handsome; though in men it sometimes takes a character of simplicity and firmness. According to the Greeks, the high forehead never bore the palm.

Our Monthly Edition.

Science Siftings may now be obtained in Monthly Parts, bound in buff wrappers. Price 6d., or post free, 8d., of any Newsagent; or of the Publisher, 78, Fleet-street, E.C.

HOW THE DRY LAND WAS SEPARATED.

Geology deals chiefly with the surface features of the earth. Much has been written in regard to the elevation of the mountains, the shaping of the valleys, and the formation of the strata. But there are other problems whose solution has hardly been attempted. We refer to the rationale of the elevation of the land above the level of the sea bottom, and to the cause of the trend of the ocean coasts.

If the water were removed, the land would appear as immense plateaus rising abruptly ten thousand feet and more above the great valleys that separate them. The existence of such enormous masses so far above the general level, in apparent defiance of that law of hydrostatics—the surface of fluids must be level—is first to be accounted for, since, although the earth's crust is solid enough new, there was a time when it was fluid.

Another problem, yet more difficult, confronts us when we consider the contour of the continents. There is a remarkable parallelism between the opposite shores of the Atlantic. If we could move South America over to the west shore of Africa, its eastern angle would fit surprisingly well into the Gulf of Guinea, and the two coasts thence southward would almost coincide. The great western projection of Africa fits into the recess between North and South America. Thence northward the parallelism is almost perfect, Labrador and Newfoundland fitting into the Bay of Biscay, while the plateau on which are the British Islands, and whose boundary is the one-hundred-fathom line, fits with some approach to accuracy into the opening of Baffin's Bay.

Looking at other parts of the world, we notice several more parallelisms. New Zealand, on its western shore, is almost the exact reverse of Australia, although one thousand miles away. Tasmania fits pretty well on the southern corner of Australia, and Papua (or New Guinea) on the north side. Madagascar agrees better with the west side of Australia than with the east coast of Africa. The east and west shores of Baffin's Bay are singularly parallel.

If we turn to the Pacific, and study the trend of its shores, we find very different conditions. The eastern side of Asia, instead of being parallel to the opposite shore of America, is almost perpendicular to it.

These problems—the elevation of the plateaus, the parallelism of the Atlantic shores and of some inland shores, and the perpendicularity of the Pacific—must have presented themselves to everyone who has given the early history of our world the slightest consideration. The literature of the subject, however, is small. The belief of geologists, in a general way, appears to be that, as the earth cooled, a crust was formed all over it with tolerable uniformity; that as the interior cooled and shrank, the immense weight of the crust produced corrugations on its surface, and that these were, from some cause, not distributed uniformly, but in huge patches, the largest being what we now call the eastern and western continents. This would partially account for portions of the earth's crust being higher than the rest, but not at all for the direction of the trends.

In a manual of geology we find, "The continents were the parts of the earth's crust that first stiffened in the gradual cooling of the exterior. These parts sank as they solidified, and, of course, there was an overflow from either side, which also cooled. And this process went on until the mass became too viscid for it to continue. Finally, a layer of crust-rock, miles in thickness, was made over the great continental areas. Throughout the other portions of the sphere, the

surface, whether liquid or beginning to solidify, had one level. The earth then was one vast plain—the present continental portions solid, the oceans liquid. These liquid portions, as they cooled, would shrink more than the solid parts; hence, as they hardened into rock, they would form vast depressions; and these, now filled with water, are the present oceans. The cooling of one part of the crust before the rest must have been a consequence of less vivid heat and violent action in the liquid rock of that part, and this may have been connected with the exterior of the solid nucleus, being nearer in that part to the outer surface of the sphere, that is, to there being less depth of liquid rock over it to cool."

To this, two serious objections present themselves. It is extremely doubtful whether solid granite would sink in the molten mass—a doubt that becomes almost certainty when we reflect that astronomy has proved that the interior of the earth is very much heavier than its crust. And admitting that the theory explains the existence of the vast ocean basins which now separate the continents, it does not even attempt to explain the parallelisms which are found, except to refer them to imaginary lines of cleavage in the earth's crust. If the two continents have always been several thousand miles apart, it is difficult to see how lines of cleavage could result in parallel coasts.

Humboldt conjectures that the Atlantic basin was eroded by an ancient current, forming, as it were, an immense river; and as the sides of rivers are parallel in general trend, so should be the sides of the ocean. But the Atlantic currents are too feeble and too superficial to produce any erosive effect on the bottom of the basin. And if, in some way, the power of the current was enough greater at that time to do the work, how was the debris disposed of? There would need to be removed a mass greater than North and South America and Europe combined. What became of it? No satisfactory answer has been given.

It was long ago pointed out that the great trend-lines of the continents are approximately tangent to the Arctic circle, and from this it has been thought that in some occult way their direction was connected with the obliquity of the earth's axis. It is very difficult to see what the connection is, and until that is shown we must be content to regard the tangency as an accidental coincidence.

It may seem presumptuous to try where others have failed, but in no other way can the secrets of Nature be wrested from her. And so, without further apology, we give what seems the rationale of the continents rising high above the ocean bottoms, of the parallelism of the Atlantic shores, and of the perpendicularity of those of the Pacific.

We start with the hypothesis that once our earth, from pole to pole, was a sea of lava, exceeding in temperature and fluidity that now glowing in the most intensely active volcano. It was in a state of violent agitation; there were not only convective currents in its own mass, but it was acted on by an atmosphere probably thousands of times heavier than that which we breathe, since it contained all the waters now on or in the globe, all the carbonic acid now in the rocks as carbonates, or whose carbon is stored in the various forms of coal, lignite, or hydro-carbons, as well as all else that was vapourisable at such high temperature. This ocean of fire was a mixture of substances differing enormously in fusibility and in specific gravity.

It is highly probable that a very large proportion was iron—for our earth possesses magnetic properties, and in that resembles iron. As a whole, it is very much heavier than the continental masses; in other words, it is heavier in its interior. If two-thirds of the globe were iron, it would have about its present specific gravity. As gases are vacua to each other, so in some degree are liquids; and it must be admitted that there was a more or less general mixture of all the materials in that sea of lava. Yet, in a general way, it is true that the heavier substances were found below, and the lighter near the surface. As the temperature fell, the more infusible substances solidified first, and since these, as a class, are lighter than, for example, the iron which formed so large a part of the magma, they rose as a scum, or crust, to the top—a process which we see repeated on a small scale at every smelting furnace, in the slag which floats on the molten metal.

The slag, or crust, formed on the lava would gradually increase in thickness, very much as ice increases on the surface of a pond. Twenty, thirty, or a hundred miles would not, relatively speaking, be very thick for such a formation. Such a process, *if undisturbed*, would have covered the globe uniformly—substantially so—with a crust of present-rock materials, very much as ice covers and floats on the surface of a pond. As the interior continued to lose heat, consequent contraction went on, which tended to produce elevations and depressions in the floating crust—wrinkles on its surface with as little system as those on a withered apple.

Such might now be its condition, but that other forces were at work tending to break it up, and thus prepare it for re-arrangement in one or more masses. There were the lunar tides, and, in a less degree, the solar tides. These, in seas thousands of miles in depth, must have been much greater than ocean tides now. Their effect was to weaken the crust by frequent flexure, and to cause a slow relative movement westward. There were also enormous eruptions of vapours and gases, such as now occur in the sun; and there were seismic forces probably incomparably greater than any now known. To these was added the influence of cyclones, which in such an atmosphere and with such enormous temperatures must have immeasurably surpassed any that now arise.

(*To be concluded next week.*)

MORLEY MEMORIAL COLLEGE.

The Morley Memorial College in Waterloo-road, of which Miss Cons is honorary secretary, and which has done so much to provide scientific, literary, and technical training for artisans and others, has arranged a Friday evening course of ten lectures on Shakespeare, by Mr. F. S. Boas, M.A. The first lecture is fixed for the 7th inst., and the fee for the entire course is 1s. 6d. The following fixtures have also been arranged:—October 4th—Sir John Lubbock, M.P., F.R.S., L.C.C., will give an address on "Books," and afterwards distribute prizes and certificate to the successful students of the Morley Memorial College. October 11th—Mr. C. T. Dent (late president of the Alpine Club). "The Alps in Winter"; illustrated with original photographs by means of the oxy-hydrogen lantern. October 18th—Mr. F. W. Rudler (curator of the Geological Museum, Jermyn-street). "Frost and Fire"; with special reference to the late flood at St. Gervaise and eruption of Etna; illustrated with dissolving views. October 25th—Colonel Swinhoe, F.L.S., F.Z.S. "Some Curiosities in Nature"; illustrated with dissolving views.

ABOUT CHRYSANTHEMUMS.

The chrysanthemum has only been cultivated generally in this country for about half a century. Notwithstanding its short history on this side of the sea, it is now more generally cultivated than any other flower except the rose, and I have my doubts whether it be not even more popular than that of all flowers. The chrysanthemum being hardy and very grateful for attention, and blooming at a time of the year when it shares attention with very few other flowers, it appeals very forcibly to all lovers of beauty. These reasons are those which have made in the past two decades the chrysanthemum grow so rapidly into favour that it is now the people's flower—everybody's plant.

The chrysanthemum is indigenous to Japan and China, where it is very generally distributed; at the same time there is much uncertainty in determining the different species from which our garden varieties have sprung, for chrysanthemums have been created in the gardens of the Celestial Empire and the Flowery Land from time immemorial, and degenerated varieties of cultivated forms have for centuries past become widely naturalised. The botanists recognise only three distinct varieties, but the gardeners cannot even insist that these are distinct, for they have demonstrated time and time again that all the different types of chrysanthemums may be raised from seed saved from one plant. This, however, may be due to the continuous intercrossing by natural and artificial means that has been going on among these plants for many years.

In Japan the chrysanthemum is the national badge; and nowhere else has its cultivation reached such perfection or are its finer varieties more zealously guarded. Common varieties are plentiful enough in the gardens of the masses and easily procurable, but the choicer varieties are confined to the imperial gardens and the gardens of the nobility. There was a time when these could not be had for love or money, and it is hard enough to get any of them now. But within the past few years some of these rarer varieties have found their way westward. The Dutch took the chrysanthemum from Japan to Holland, and in 1869 we learn that they were cultivated in some of the gardens there. But we lose sight of it as a garden plant in Europe until 1764, when we found it grown in the Apothecaries' Botanic Garden in Chelsea. It was not, however, grown to any extent till some years later, when a French merchant brought three varieties from China—white, violet, and purple. Only the last of these lived, but it was widely propagated, and in 1790 found its way into England. During the next twenty years a great many new varieties were introduced from China into England, and it was a most popular flower. In the course of time it found its way to America, where now it has grown as successfully and in as many varieties as anywhere in the world except in Japan.

The different types of chrysanthemums are known as Japanese, Chinese, and Pompone; and these are again subdivided into large and small flowered forms, incurved and reflexed forms, and anemone-centred forms of all three. But while extreme cases in the three leading classes are very marked, intermediate forms occur where it is almost impossible to decide in which class to rank them, there being no rigid line of demarcation between them. There are grown in America at least 1,000 of these varieties, and one gentleman in Boston reported ten years ago that he had cultivated in his garden 600 sorts. In rural districts chrysanthemums are often called artemesias. The artemesia is the generic name for wormwood, southernwood, mugwort, and tarragon: and although all belong to the great composite family of plants, the artemesias are not very closely related to the chrysanthemums, nor do they look like them.

A fresh stock of plants should be gotten up every year, for young plants, as a rule, are thriftier, and produce finer flowers than do old ones. The common way is to lift, divide and replant the old roots in the early spring, or take strong, well-rooted sprouts from the sides of the old plants and set them out. Chrysanthemums are, however, as easily raised from seed as are China asters, feverus, or Indian pinks. Sow the seed in pots or shallow boxes filled with light soil, and place them in the window of a warm room, or in a hotbed or greenhouse as one would tomato plants. If the seeds are sown this way in early spring, and the seedlings after they have come up a little are placed singly or in other pots or boxes, then gradually hardened and planted out in the open garden early in May, all, or at least most of them, will bloom the next season. While young plants raised from side sprouts or cuttings will continue to be identical with their parents, no one can tell what varieties will come from the seedlings, as from the seed saved from one plant we can raise flowers of the various classes and all the colours peculiar to the race. Seedlings generally have an excellent constitution, and when in bloom make a fine display, but when it is desired to continue a special sort, this must be done by planting sprouts or cuttings of the old plant.

The only way the large flowers—such as those to be seen at exhibitions—can be grown is by feeding the plant very liberally and by disbudding. This disbudding process consists in thinning out the buds as soon as they can be seen, and leaving only two or three of the plumpest and most perfect ones on each shoot. Some persons find more pleasure in growing one large and finely formed flower than in a whole bunch, or even a gardenful, of indifferent blossoms. By this process almost any of the varieties will produce flowers three or four inches in width. These gorgeous blossoms of the Japanese varieties, sometimes ten and twelve inches in diameter, are always restricted to one bud to a shoot. The exposure of the bed in which chrysanthemums are grown has a great deal to do with the success of the flowers. They bloom late, and they should be shielded from the north winds by a house, a fence, or shrubbery. When those that bloom outside are killed by the frost they should be cut off and the roots mulched with the tops or some other litter, such as straw or leaves.

Although the chrysanthemum is usually only grown for the autumn and early winter months, yet by taking the first young shoots that start from the old plants which are flowering in the early part of the winter, and placing them in a propagating bed, they will root in a few days. If grown in the ordinary greenhouse temperature during winter, shifting them into larger pots as their necessities require, by spring they will make fine flowering plants.

The Index to Volume I.

may be obtained on application to the Publishers, price 2d., post free, 2½d.

Covers for binding Vol I, price 1s., post free, 1s. 2d.

Or through any Newsagent.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

SIFTINGS OF THE STUDY.

Publishers sending books for review are requested in all cases to state the price of the work.

Cassell's Storehouse of General Information.

(London : Cassell and Co., Limited.)

The volume of the "Storehouse of General Information" under review is the second published, and includes from "Castro" to "Deodar." The work fully bears out the promise implied by its title, and is full of interest alike to the man of the world and the scientific student and naturalist. The book is well illustrated, and contains among its list of plates a chart of the heavens (North and South Hemispheres), a map of North America, a series of crystallographic diagrams, a map of London, and some good drawings of dogs and animals of the dog tribe.

Stray Studies from England and Italy.

By John Richard Green.

(London : Macmillan and Co.)

"Stray Studies from England and Italy" is practically a collection of reprints of papers that have originally run through *Macmillan's Magazine* and the *Saturday Review*. In many cases, however, the original form, as stated by the author in his preface, has been greatly changed. The sketches of towns on the Riviera are as delightful as anything of the kind we have as yet read ; and in following the author we feel ourselves already transported to those earthly paradises. The author is, however, as much at home in ancient history as in his descriptions of contemporary scenes and events, and his chapter on "Æneas: A Vergilian Study," bears testimony to his thoroughness. To students of topography, of geography, and of men, manners, and customs we heartily commend this work. It is instructive in the extreme, and vivacious and interesting withal.

Nuttall's Standard Dictionary.

(London : Frederick Warne and Co.)

A new edition of Nuttall's Standard Dictionary reaches us. It is considerably larger than its predecessors, and, needless to say, is thoroughly up to date. An entirely new feature is introduced by printing in italics at the end of meanings the actual derivations of the words. This, we need hardly say, will be most welcome to all students of etymology. A list of classical and geographical names is also added, and the dictionary is embellished with many illustrations. The work is published at the low price of 3s. 6d.

TO WHAT DOES THIS REFER?

Seven hundred and twenty-eight correspondents have kindly enlightened us about this query, but Mr. G. H. Thiselton-Dyer, Royal Gardens, Kew, happened to be the first whose letter we opened, so we have sent the five shillings to him.

Thirty-nine out of fifty-one cases of scarlet fever reported to the Leyton Local Board, have been traced directly to milk that came from one dealer. Doubtless the remaining twelve cases arose from a similar cause. All this evil might have been prevented had the milk been sterilised. We give, in another column, an excellent method of sterilising milk, and advise our readers to try it.

A THEORY OF LIGHT.

Development of the theory of light has made considerable progress of late years, and its true nature is correctly defined ; but, according to the views of a correspondent, scientists are still somewhat off the track as regards certain minor points, such as the illumination of opaque bodies. A beautiful analogy exists between the phenomena of sound and light. It is universally understood that both are results of the same great force—motion. Motion in the atmosphere and motion in that mysterious fluid, ether, appeals to our senses, the former to our ears, the latter to our eyes, producing the effects we call sound and light.

Now, ether is that subtle fluid filling all space, permeating all matter, the media of light-waves whereby light and heat are transmitted from the sun to our earth. There is an intense agitation and commotion of particles continually going on in the sun, and these impulses transmitted to the surrounding ether are carried on and out in ever lengthening lines, until some of them strike our interfering atmosphere and we have the phenomenon of light.

Darkness, the writer points out, is due to the absence of light, and light, we have just seen, is atomic vibration ; hence, darkness must be comparative passivity. Go to your room at night when all is dark, and you see nothing whatever, for the composing atoms of each object in that room are in comparative rest. But now light the gas ; immediately vibration is set a-going by the combustion, and passing on it agitates the atoms of every object present. You now look at matter made visible not by reflected rays, as commonly supposed, but by light-waves of their own creation, caused by the imparted energy. A luminous body is the source of etheric light-waves, while an opaque substance is made visible by the presence of a luminous one.

Light is as much more subtle than sound, as ether is than air, and the general truths of the one apply to the other, and *vice versa* ; hence, in tracing the analogy we discover a beautiful correspondence between sympathetic *sound* vibration and light illumination, which we at once see is nothing more than sympathetic *light* vibration. The rays of the sun reach the side of the moon visible to us, creating among the atoms of that body a violent agitation. When they strike, their office is fulfilled, their motion has been checked, and they cease to be. But now the commotion of the moon's particles imparts its energy to the surrounding ether and thence to us, giving us the delightful evenings of full moon. Give credit where credit is due, give the honours to the moon and stop heaping them upon her big brother, sun. She vibrates in sympathy with his vibration, the analogy here being perfect—stop the source of the sound and there would be no sympathetic vibration from a neighbouring instrument ; refuse the moon the presence of the sun and she would ever remain invisible.

In the particles of most matter composing opaque bodies, sympathetic vibration ceases the moment the luminous one is removed, the atoms returning to their original comparative passivity. Some substances, however, are exceptions, such as the sulphides of calcium, strontium, etc., which retain, for a short time, the imparted energy. It is to these substances we attach the name, phosphorescent.

This somewhat meagre outline of light propagation, the writer thinks, may be profitably extended in all the various phenomena of light, with interesting results. We are not yet at the end of the tether of discovery, many startling facts await our persevering efforts.

HOW DECAYED MATTER GIVES LIFE.

All plants or portions of plants after the termination of life undergo one or the other or both of two processes of decomposition, one of which is known as *fermentation*, the other as *putrefaction*, both similar processes, the latter, however, taking place only in materials containing albuminoids in some form.

Each of these, so far as the changes are concerned, is only a slow combustion, the portions having an affinity for oxygen entering into composition with that element during a course of days, months, or years, which process is often completed in burning in as many minutes or seconds. (It is now known that each of these two processes is developed and carried on by appropriate micro-organisms, which cause the chemical changes for the purpose of appropriating elements necessary to their own existence.)

We take the following from a work of Baron Justus von Liebig:—

"The decomposition of the chief constituents of all vegetable and of all kinds of ligneous fibre presents a phenomenon of a peculiar kind. Surrounded with air and hence with oxygen in contact, the oxygen absorbed is converted into an equivalent volume of carbon dioxide (formerly called carbonic acid gas). The process ceases whenever the oxygen is exhausted from the contiguous air, but is renewed whenever oxygen is again supplied. But in the case of humus, (soil formed by the decomposition of animal or vegetable matter) the process is not carried to the length it is in ordinary combustion, though as far as it goes it is of the nature of that combustion, for the time comes in any particular mass when the absorption of oxygen ceases even when surrounded with a plenteous supply of that gas, and the humus becomes, under ordinary circumstances, an unalterable brown or coal-black mass known in common parlance as mould. This then is the first and most important product in the decay of wood. It is the chief constituent of all sorts of peat and turf. By great pressure it can be reduced to bituminous coal and by heat and pressure to anthracite. But by contact, however, with alkalies, lime, and the like, the decomposition of mould can be carried further, rendering much more carbon dioxide for growing plants.

"In a soil which in its depths is accessible to the air, the action in the humus will be just like that which takes place when the mass is exposed to the air at the surface, and here as elsewhere oxygen is slowly exchanged for carbon dioxide.

"Each little particle of decaying vegetable matter is surrounded with an atmosphere of carbon dioxide which it has obtained at the expense of the air on one hand, and of a part of its own weight of carbon on the other. Now, in the cultivation of the ground, *here is the philosophy* of constantly loosening up the soil, for this process renders the access of air to the depths beneath free and unhindered and thus often promotes the production of carbon dioxide to an extraordinary degree.

"It is without doubt true that in the earliest development and growth of plants carbon dioxide is not needed. Before the development of the leaf with its cells of chlorophyll, to which its green colour is due, the plant is unable to assimilate the carbon dioxide of the air. At the expense of the reserve material and the little plant germ, packed away in the seed, grow the primitive organs of the new plant, the first roots and leaves (the radicle and plumule). But once the leaves are formed then commences the assimilation of carbon dioxide.

"Now remember that the matter stands thus, no plant growth can take place without either free carbon dioxide at hand, or some material, with this gas exhaling therefrom, applied to the roots, hence, the great store of this gas in the soil from which the roots can draw a supply is a thing not to be undervalued. Humus promotes plant growth not then by being itself absorbed in a soluble form and thus becoming assimilated, but because it furnishes in solution carbon dioxide, and other indispensable plant-growth-promoting elements, all of which the roots can find at hand to absorb so long as the conditions of decay, moisture, and oxygen are united together in their action upon the humus.

"As the carbon dioxide is passing up in the sap from the roots, there is a considerable portion that passes to the outer air by diffusion, and hence it is readily understood that plants, which shade with their leaves the ground as with a thick ceiling or roof overhead, and hence retard or prevent the air rich in carbon dioxide beneath from being driven away or interchanged with the outer or upper atmosphere, have a large supply of the gas to breathe in through their leaves, to be here changed into carbon for the growth of the plant and into oxygen to be breathed out into the atmosphere. Let it be remembered here that the humus contains also as a residuum of the decaying vegetable matter, all the nitrogen the plant will need, but even this is supplied because of the decomposition that goes on that chiefly supplies carbon dioxide."

When Liebig wrote the above, the grand discoveries made in the domain of micro-organism were all matters of the future. Not only is it now known that fermentation and putrefaction are caused by appropriate microbes, but that numerous diseases now generally known as zymotic, are also so caused, hence the wonderful revelations of Dr. Koch, of Berlin, and Pasteur, of France, and others who have followed these leaders, but these discoveries in no way invalidate the description of the processes of decay or their relationship or result as stated by Liebig.

It will make no difference as to process or result to say that the oxygen of the air has a very great affinity for the carbon and hydrogen in the materials of which vegetable and animal frames are composed, and, hence after death because the composition of these materials is very complex, the oxygen succeeds in easily oxygenating the carbon and hydrogen, thus setting the stability of the compounds which thus separates up into two or many divisions, a process known as fermentation or putrefaction as there should happen to be no albuminous material or the reverse in the compound, the old view, or to say that micro-organissm or microbes in the course of their life history for the very necessity of their existence, demand certain elements in the compound which being appropriated upsets the stability of of the compound which thus separates into two or more divisions, known as fermentation or putrefaction, etc., the new view. The cause has been discovered, that is all. The earlier chemists not knowing the cause, and needing one, endowed oxygen with a sort of life, a disposition to destroy all complex organic material and set it to work to restore to the air all the gases derived from it by the processes of plant growth.

Liebig in making humus, or decayed matter, the chief source of carbon dioxide did not mean to ignore the enormous source of this gas in animal breathing, in ordinary combustion and in many cases, in volcanic action, all of which is absorbed from the air by the leaf. What a wonderful little laboratory do we find in the chlorophyll cells, for with the sun's ray as a chemist, and carbon dioxide as the material, carbon is

made for the growth of the plant, and oxygen thrown out into the air. The human chemist, by much labour, can separate carbon from the oxygen in this compound, but he has only the carbon for his pains, for the oxygen goes off in affinity with some other element, or if he gets the oxygen, the carbon goes off with some other element. In other words, the human chemist cannot divorce carbon and oxygen without at the same time marrying one or the other to some other element, but the sun's ray does it perfectly, and yet so silently that you hear not the sound and knows not how it goes on.

In Liebig's day, it was believed that plants could not assimilate free nitrogen from the air, but could get it only from ammonia or other compounds of nitrogen either in earth or air, but chiefly in the former. It is now known that nitrogen, in small quantities, can be assimilated by the plant directly from the air, and that various compounds of this gas, so very necessary to life of all kinds, vegetable and animal, are actually manufactured from the air.

In Liebig's day it was believed that it was only possible to make the nitrogen of the air to unite chemically with the oxygen of the same, by passing through the air intense sparks of electricity, which would thus produce minute portions of nitric acid, which, brought down by the rain, would be at hand for the use of plants, but this source is very meagre, and does not balance the decomposition of ammonia nitrates, which keep supplying the atmosphere with more nitrogen, and if this destructive work was continued, the time would come when the earth, with no change in climate, would not have a supply of compounds of nitrogen sufficient for an increase in either the animal or vegetable population of the world, but the balance is kept up, the cycle is perfect.

RHYTHM IN PLANTS.

Some interesting experiments in the artificial production of rhythm in plants have been exhibited by Francis Darwin and Miss D. F. Pertz. The plant under observation was fixed to a spindle, and by a clockwork escapement was given a sudden semi-rotation at the end of every half hour, which caused a series of alternations of the direction in which the plant tended to curve, through the influence of either light or gravitation. This induced a rhythmic state closely resembling the periodicity set up by the alternation of day and night. Stopping the clockwork gave a remarkable result. The plant continuing to curve with an acquired rhythm as before, having in fact, learned and remembered the half hour period. This is precisely similar to certain natural rhythms, such as the regular opening and shutting of flowers for a short time after being placed in constant darkness.

VOLUME I. OF "SCIENCE SIFTINGS"

CAN BE HAD

Bound in Cloth and Gold, 5s. Postage 6d. extra.

From the Publishers, Messrs. W. H. Smith & Son, or through any Newsagent.

A few numbers of each issue of Vol. I. (fro No. 1 to 26) are still obtainable, price 3d. each.

SOCIAL SCIENCE.

OVER-SENSITIVENESS.

There is no more unhappy class in the world than the over-sensitive people. They are constantly at contraries with the conditions of existence, and most of their time is spent in useless fretting and repining. The least puff of adverse wind is sufficient to ruffle their peace of mind and turn their pleasure to irony. Their nerves lie upon the surface like tender vines, responsive to every inclement touch. They have no power of resistance, no skill of avoidance, no qualification of patience. The small ills and worries that they ought to bear without complaint as a part of the common experience of mankind they rebel against with tireless lamentations. They torment themselves far more than they are tormented by others, and seem to be always looking for pretexts of agitation and discomfiture.

Nothing ever quite comes up to their expectations where the question of enjoyment is concerned, but every pin-prick of annoyance is magnified into a swordthrust. They are so organised that gracious and wholesome influences visit them lightly, while grim and sinister ones possess and control them absolutely. Their plight is ludicrous at times, and it is as frequently pitiable. They are helpless in a sense, and yet it is difficult to be indulgent with them, or to feel the sympathy for them that they probably deserve.

These unfortunate people are exceedingly imaginative, and live in persistent dread of troubles that they have no valid cause to anticipate. They suffer as much from things that do not happen as from things that actually come to pass. A mote to cloud the ordinary mind's eye for an instant only becomes to them a beam that is the source of prolonged irritation and dejection. They do not know how to discriminate between what is real and what is unreal in the appearances of evil that are always visible. It is enough for them to see a flitting conjecture of approaching mischief, and they are at once panic stricken; they do not stop to analyse the situation and to test the unpleasant sign by the rules of logic and the lessons of experience.

The air-castles that they construct are all tenanted by the spirits of darkness. When they look into the future they find nothing but chances of disappointment and auguries of catastrophe. It is profitless to tell them that the forces of good are stronger than those of harm in the philosophy of the universe, as the progress of the race testifies. You cannot make them believe in such a theory, because they will not consider the matter from any other than a nervous point of view—with their feelings instead of their reasoning faculties. They are intelligent, generally speaking, and do not mean to be wilfully blind to comforting and encouraging facts, but their minds are fundamentally distorted, and all their impressions take crooked and misleading shape accordingly.

It goes without saying that the thin-skinned person is a confirmed egotist. He invests his personality with an exaggerated importance. and flatters himself that the world indorses the estimate. It never occurs to him for a moment that he may be mistaken in his supposition that all those who know him are taking a profound interest in his private fortunes, and neglecting their own affairs to watch his struggle with opposing circumstances. His self-esteem is so absorbing and far-reaching that he easily overlooks the salutary duty of comparing his merits with those of other men in an impartial way and asking himself if, after all, he is getting his due share of success.

There is but one figure in his horizon, and that is his own. He acts upon the implied hypothesis that in taking the trouble to be born he acquired a claim to superior consideration, together with the right on his part to ignore all the rest of mankind except for the promotion of his individual purposes. He depreciates himself now and then, to be sure, but it is always with a suggestion that he desires to be contradicted. That is his way of being vain of his vanity, so to speak. It suits him to assume a virtue that he does not possess, only with the hope of emphasising the point which he seems to be modifying. If you venture to take him at his word and agree with him as to his confession of fault or weakness, you quickly discover that you have misunderstood him.

In a majority of instances—in every instance, more or less—such a character is permeated with selfishness. It rarely or never lends itself to a liberal or noble use. When it does a favour or makes a sacrifice it simply negotiates for a larger advantage in return. It casts bread upon the waters only under conditions which promise that the crumbs shall speedily come back multiplied into loaves. The thin-skinned people are not the philanthropists and benefactors of the world. They are too busy with their personal fretting and protesting, envying and scolding, to try the experiment of attaching themselves to their fellow-men by services of true kindness and tenderness.

The idea of spontaneous and disinterested friendliness is entirely foreign to their methods and tendencies. They are wrapped in selfishness as in a mantle, or as in an armour, rather, and every issue of generosity is determined with reference to their prospects of ultimate private gain. It may be charitably surmised that they do not always realise the motives by which they are governed in their relations to other people; but it is a melancholy fact all the same that they are sadly wanting in that attribute of human nature which is most admirable and praiseworthy, as well as most essential to usefulness and happiness. They are what they are, in short, largely because they lack the gift of living outside of themselves.

There is a settled fear in the mind of the thin-skinned man that somebody is going to hurt his feelings by challenging his right to the place that he occupies. He is particularly sensitive concerning the humble conditions of his origin and early life. Nothing gives him greater pain than to be reminded that he was obscurely born, and that he began his career by running errands, keeping books, or tilling the soil. He wants to forget that he was a tadpole before he became a frog, and the fact that other people insist upon recollecting it is one of his sorest mortifications.

Even when it is cited with a view to complimenting him upon his triumph over serious hindrances he resents it as an implied slur. Most men recall such points in the story of their lives with honest pride, and like to tell how they were helped by the harsh discipline of poverty and plebeian toil to accomplish satisfactory results in later years; but he is a stranger to that kind of a feeling. He looks back to his errand-running days with a sensation of shame which proves that whatever pretences he may make to gentility he is in reality a vulgarian.

When a man of this kind enters public life he bids farewell to repose and places himself at the mercy of disturbing and depressing influences. The criticisms that inevitably attend such a career are an overpowering terror to him. He feels that destiny is in league with his assailants to destroy his character and make a mockery of his well-meant endeavours. The consciousness of innocence does not suffice to blunt the shafts of calumny and does not give him strength to rest his case upon his record of honesty and fidelity. He gives the public no credit for an intelligent comprehension of the animus of attacks that he knows to be unprovoked and unjustifiable. His suffering is so keen that he loses sight of the fact that society does not judge a man by what is said about him for political effect.

The misrepresentations that he takes so much to heart are far less injurious than he imagines; but his vanity imparts a fictitious importance to them, and that is the only light in which he will consent to regard them. He broods over them from day to day with steadily augmenting unhappiness. The more he thinks about them the larger and darker they appear to him. If he undertakes to correct or resent them he is apt to increase rather than to diminish his trouble; and when at last he is driven to irresponsible distraction, he ends the conflict by taking his own life. His egotism dethrones his reason, that is to say, and thus "through love of self himself he slays."

It is better to have the hide of a rhinoceros, like the average politician, than to be encased in one of these over-sensitive cuticles. The man who pursues the even tenor of his way, indifferent to the abuse of his enemies, and heedful of the obligations of personal integrity and efficiency, will usually succeed. He may encounter temporary defeat, but in the long run fate will give him the victory. This truth has been repeatedly illustrated in our politics. Some of our greatest statesmen have been systematically derided and traduced, but that did not dim the splendour of their services, or prevent the country from honouring and rewarding them according to their just deserts.

They did not squander time and energy in exposing their private grievances to the popular gaze, but took it for granted that a proper distinction would be made in favour of a record of faithful devotion to duty as against malicious carping and detraction. If they had been thin-skinned they would have succumbed to the annoying and discouraging forces over which they finally prevailed, and their names would not have found a place in history. But they were blessed with that healthy and unsusceptible epidermis which is only another name for one of the most profitable forms of practical wisdom. They did not torment themselves with abnormal fancies and exaggerated difficulties, but went bravely forward, with confidence in their abilities and trust in the good sense of the people.

There are occasions when it is necessary for a man to take notice of charges that are made against him by newspapers and other agencies of public criticism, but that can be done in such a manner as not to sacrifice self-respect or invite a suggestion of improper sensitiveness. The people like a man who returns blow for blow in a case of that sort, and does not defend himself in a whining fashion. As a rule, however, silence is the most effective weapon, provided the accusations are inspired only by prejudice or malevolence. A falsehood is short-lived when left to itself, and prudent men prefer to let it die in that way, but the man with a thin skin hastens to call attention to it by publishing a denial, and that gives it a chance of prolonged survival in repetition and elaboration.

The cunning fabricator sets traps of this kind for the feet of such men every day. If they would but decline to be caught, which means, if they would but suppress their indignation, they would be surprised to see how soon a slander loses the power of mischief by being ignored. Most

lies invented to discredit a public man have a grain of fact in them, and when he begins to explain he is gone, whereas no harm is done when he turns the matter over to the public without any attempt to show how he has been maligned. The lesson is a hard one for an impulsive and sensitive man to learn, but it is a useful one, nevertheless, as has often been demonstrated.

The thin-skinned people are so constituted that they cannot appreciate the advantage of biding their time. They want every day to be sunshiny and floriferous, in violation of the laws by which the affairs of our planet are adjusted and controlled. It does not satisfy them to be assured that there is more felicity than misery in the world, and that their own lives, when contemplated according to the doctrine of averages, present a distinct surplus of good over evil. They will not reconcile themselves to present ills by looking to future benefits, but insist that the books shall be balanced at the end of each twenty-four hours. Their philosophy makes no allowance for the blunders and accidents by which personal success is merely postponed, and not defeated. It fails, also, to take account of the significant fact that we earn our right to prosperity by our endurance of disagreeable things and our facility in the shaping of unfriendly circumstances to pleasant and profitable ends. They are not willing to forego their custom of complaining until they find out if there is really any ground for complaint. The little nibbling, mouse-like cares of life distress them as much as serious trials and misfortunes do other people. They are happy only when unhappy, as it were, and all their thoughts are bordered with black, after the manner of funereal messages.

A STRANGE EXPERIMENT.

Take a strip of paper of any convenient length and breadth, says the *Boys' Own Paper*, bend it into ring, giving it a half twist on the way, and unite the ends with gum. Now if you divide this ring lengthwise upon the centre, what will follow? At first sight it certainly looks as if you would produce *two* similar rings. Take a pair of scissors and try. You will find when you have cut through the length of the ring that, instead of having two, you still possess *one* ring or band, but twice the length of the original one, and with a double twist or "kink" in it difficult to describe. On repeating the cut you will, however, obtain *two* bands, curiously linked together, and inseparable. The experiment may be varied, with equally unforeseen consequences, either by commencing the first cut at a distance from the edge of the ring equal to one-third of its breadth, and continuing twice round until the band is divided, or by giving the paper an *entire* twist before gumming.

A little consideration will perhaps enable you to account for these singular results, the strangeness of which has been thought to afford some sort of illustration of what is called the fourth dimensions—a condition of existence other than ours, with regard to which men of abstract science have indulged in some remarkable speculations bearing on the nature of a spiritual world.

HELPFUL HINTS.

A Misprint.

J. H. Belcher and R. T. Lewis.—We are indebted to you for directing our attention to misprint on p 312. The paragraph was written with reference to the theory of the *elongation* of the sun and moon, in a horizontal direction when near to the horizon.

Condy's Fluid.

Dan. Eley.—The only essential ingredient is an alkaline permanganate. We believe that in making up the fluid on a large scale *sodium* permanganate is used on account of its cheapness. However, you would probably find the potash salt more readily procurable. You can buy a pound of permanganate of potash from a chemist for one shilling, and this will keep any length of time and will serve for an enormous quantity of the fluid. No special directions are needed for making up. Simply dissolve a little of the salt in water, judging the strength of the solution by its colour.

Optical Instruments.

W. H. H.—There are slight differences in the relations of the curves of the optical lenses in telescopic instruments intended for different purposes. Opera glasses, field glasses, marine glasses, terrestrial and astronomical telescopes are intended in the order in which we have named them for the examination of objects at successively greater distances from the eye. Any one of them may, however, when suitably focused, be employed for the purpose of any of the others. The quality of marine glasses is generally, but not always, proportional to the number of lenses employed in their construction. Your other questions will be replied to in our next.

Miscellaneous.

B. J.—We think "A Treatise on Paper," by Richard Parkinson (Crosby, Lockwood, and Son), will meet your requirements.

Gerard Smith.—Your communication is extremely interesting, but the questions you raise are a little too medical for discussion here We heartily agree with you, however, that the pure ptomaine of the small-pox bacillus should be isolated from all other products for purpose of vaccination against small-pox.

One who feels infinitely disgusted.—If you really wish to help us send your name and address.

Electro-Therapeutist.—Your opinions are warranted by the facts. However, you will now hear more of the matter—we hope through the daily press. Sorry the new title does not meet with your entire approval, but we think it will please most of our friends.

Edward Harris.—Our disgust equals yours. The word was "writ satiric."

David Rodan.—Our correspondent has already gone elsewhere.

Appleby King.—The publication of your letter would be the means of teaching charlatans a trick long since forgotten. Thanks, however, for your interesting communication.

W. T. Davis.—Thanks for your communication—see adjoining column. "A Strange Experiment."

M. J. Allen.—We do not know of any accredited explanation for the alleged action of "divining rods" for locating water. You will find an article on this subject in our issue of 12th March last; and, as to the possible application of the idea there advanced to the discovery of subterranean water you may refer to our "Gleanings" in the issue of 19th March.

E. A. Kennedy.—We understand your query as inviting free advertisement, which we must decline to give.

Alex. Callander.—You are right as to the probable fate of the earth-moon system. See "Science Queries and Answers," No. 119. It is possible enough that our planet may eventually take part in the formation of "a new heavens and a new earth," but there is a limit in the future, as in the past, beyond which astronomical science can scarcely hope to penetrate.

Jas. Winterson.—The primary function of the cœcum is a matter involved in some obscurity and one that has been the subject of much discussion in medical circles. These interesting speculations are available to the *student* of physiology, but they are scarcely suited for general reading nor for critical examination in our columns.

L. Leroy.—There is absolutely not one established fact that lends support to the theory of the possible existence of such four-dimensioned space. The position assumed by us is simply this: that the laws and properties of Nature are not necessarily embraced within any assignable limits of human experience or perception.

Dallmeyer's Photographic Lenses,

Astronomical and Terrestrial Telescopes, Microscopes, etc.,

Have received the Highest Awards wherever Exhibited.

Catalogues Free on Application. Dallmeyer "On the Choice and Use of Photographic Lenses" (8th thousand), post free 1s.

J. H. DALLMEYER, Limited, 25, NEWMAN STREET, LONDON, W.

SCIENCE SIFTINGS
A CHATTY JOURNAL
Scientific Invention Discovery and Progress.

PUBLISHED WEEKLY. ONE PENNY.

Notice to Subscribers.

SCIENCE SIFTINGS *will be forwarded post free, for one year, to any country in the world, on receipt of 6s. 6d. 6 months, 3s. 4d., 3 months, 1s. 9d*

Advertisement Offices: 167, & 168, Fleet Street, E.C.

'Sale and Exchange' Advertisement Offices: 78, Fleet-street, E.C

Publishing and Editorial Offices: 78, Fleet Street E.C.

AUSTRALIAN AGENTS:—R. A. THOMPSON AND CO., Sydney Melbourne, Adelaide, and Brisbane.

LONDON: SATURDAY, OCTOBER 15, 1892.

NOTICE.

Next Week the Title of this Paper will be changed to:

SIFTINGS.

The Tit-Bits of Thought

on

Health, Science, Food, Invention, Literature, and Sociology,

In view of a most startling announcement that will be made in these columns next week, we anticipate that the demand for SIFTINGS will be abnormally large. Therefore our readers and the trade are advised to order the paper early.

ELECTRIC BELTS.

The Electropathic and Zander Institute has taken proceedings for libel against this Paper. The matter in question is, no doubt, well within the recollection of our readers, and, of course, we have no desire to comment pendente lite. *However, we shall be pleased to receive, in confidence, particulars of any* bona fide *complaints bearing on the details set forth in our articles. Our readers will thus be assisting the good cause.*

SCIENCE NEWS AND NOTES.

"To add a library to a house is like giving the house a soul."—CICERO.

Why Wear a Hat?

This is a question that has been raised again and again in the contemporary press, but never settled to the satisfaction of those to whom fashion has allotted the stove-pipe looking headgear of the present day, or those of the fair sex, who find a few inches of ribbon an efficient and certainly decorative covering. There can be no question about the origin of hats. They are a development of the animal propensity to beautify the head through natural selection for the purpose of attracting the opposite sex. A step beyond the animal we find the savage clothing his hirsute appendage with fat to fashion it into a decoration; the higher savage resorts to feathers to decorate his vertex and impress his womenkind. In civilised life, however, where the choice of mate rests almost entirely with the male, merely ornamental head arrangements are left to the female, who is supposed to use this adornment to attract the male. The male having the power of selection has no longer the necessity to resort to decorative allurements, and, therefore, employs only the useful. This is the philosophy of the evolution of the hat.

The Survival of the Fittest

is, however, the reason assigned by a contemporary for the article of clothing which lexicographers describe as "a covering for the head." Our contemporary is of opinion that there is a clearly conscious need for headgear which exists not merely in the imagination. It is thus practically admitted, we are told, that though the head, like any other part of the body, may, after having suffered the attrition of atmospheric variations, become inured to their action, it still loses somewhat in the process. In the first place, it is evident that in this conflict only the fittest can hope to survive. Civilised man will not endanger his chance of survival by risking the experiment. Further, he finds that the inferior animals thus exposed undergo external changes which do not often, if ever, tend in the direction of refinement, and instinctively he shuns the possible return to coarseness and barbarism. He also recognises the fact that, given a wholesome custom in head clothing, the consequent effect will be as healthy as it is becoming. We agree that custom has now rendered the hat a necessity, but it is well to point out that among the sanitary principles which ought to control usage in this matter are two—the avoidance of any but the lightest pressure, and the admission through the texture worn, or by special apertures, of sufficient air for free ventilation of the head. If these elementary considerations be duly regarded, and sufficient protection be provided against changes of weather, we shall find man the better, not the worse, for wearing his "covering for the head."

The Etiology of Sea-sickness

has exercised much ingenuity of late. Dr. Grailly Hewitt is an expounder of the theory that visual disturbance is greatly concerned in it, although he admits it is not the exclusive cause. For instance, the co-existence, occasionally, at all events, of blindness and liability to sea-sickness, shows that other disturbances besides those connected with visual impressions are capable of occasioning sea-sickness. This necessitates the conclusion that in any general theory of the cause of sea-sickness the visual disturbance theory cannot play an exclusive part. As a matter of fact, the phenomenon of sea-sickness is a matter of personality, to be controlled by different means in different individuals. Many, we agree, may avoid it by closing the eyes, even going the extent of bandaging them throughout the entire voyage, others may do so by fixing the vision on some object away from the vessel, and thus get rid of the sight of the complex movements of the vessel, or of any part of it. They thus undoubtedly overcome the disagreeable symptoms because they *believe* they have discovered a preventive. The faith cure again!

The rationale of prevention, however, is to diet for at least a week before starting on a voyage, ridding the system of superfluous bile, and, if necessary, resort may be made to quinine or some other tonic, to make the resisting power of the system as great as possible.

First-Rate Drinking Water

is of no little importance at the present juncture, and we, therefore, publish a method of disinfecting the fluid for household purposes, which is certainly simple and we should imagine effective. It originated with Dr. Hans Brockebusch and has been sent to the *Lancet* by a continental correspondent. A stone vessel capable of holding about twenty litres is filled to within a hand's breadth from the top with water, three heaped tablespoonfuls of cement are added, and the mixture is stirred with a large wooden spoon for five minutes. The water then clears very quickly, and is fit for washing the body and for cooking everything except pulse. To get drinking water, filter through coffee-paper into a bottle and add seltzer till the turbidness resulting at first disappears. The cement contains so much free lime that the killing of the bacilli is certain. The dissolved lime is converted by the carbonic acid of the seltzer into bicarbonate of lime, the substance to which mountain water owes its freshness. The cement must be fresh, and must not have lain beside smelling substances. Five pfennigs' (a little more than a halfpenny) worth of seltzer suffices for five litres of water.

Things Supernatural

occupy a prominent position in *Temple Bar* for the current month, where Mrs. Andrew Crosse tells a curious story of a dream that occurred to Sir John Pringle. Mrs. Crosse writes:—"In the summer of 1863 we were spending a few months at Dunkerque. The English Consul at the time was Sir John, then Major Pringle. We saw a good deal of the family, and one day, during a walk over the dunes, after we had been talking of those 'bodings unsanctioned by the will which teach us to beware,' Major Pringle related the following curious fulfilment of a dream. When a boy of fifteen he dreamt that he met with a strange accident—that he had fallen, in fact, into the crater of an active volcano, and was only rescued from his perilous position by means of ropes, with great difficulty after many hours—it seemed of durance. The dream was so vivid and circumstantial that it made a great impression on the boy's mind, and he mentioned it to several people. Years passed away, when Pringle chanced to be in Sicily, and here he joined a party of young Englishmen in making the ascent of Mount Etna. They attempted too close an examination of the crater. Pringle lost his footing and was precipitated into a cup-like depression from which it was impossible for him to extricate himself. In this terrible predicament the recollection of his dream flashed upon him. For years he had never thought of it, but now the horrible nightmare was reproduced in all its fearful realism. After a long and anxious delay he was rescued by means of ropes, precisely as he had been in his dream. Sir John Pringle was a man of undoubted veracity, and, though a Scotchman, was not addicted to a belief in second-sight."

The Hypothetical Ether,

which, half-a-century ago, was contemptously regarded as the peg upon which to hang the unknown, is becoming more and more a very definite reality to the physicist. It is to him much more than a working hypothesis. He assumes its existence, and is busily occupied in trying to understand its ultimate structure—that is, how it must be constituted in order to explain the phenomena with which it has to deal. Among the searchers after the truth is Professor Dolbear, an American scientist. Although he does not claim to have demonstrated anything new, he sees in ether, not only a medium for the transmission of the wave-motions which manifest themselves as light, heat, and electricity, but is attempting to find in it the explanation of matter itself. The old conception of the atom as simply an ultimate particle, itself dead and inert, but endowed with forces by means of which it acts upon other particles, is giving place to a radically different one. This conception is that of the vortex ring.

Any Smoker

can make such a ring, and they are frequently thrown from the funnel of a locomotive in starting. Such a ring consists of a circle of material, all the parts of which are in rotation in the planes of the radii of the ring. Physicists have conceived that such rings formed in the ether—this being postulated as homogeneous and frictionless—might constitute the ultimate something which we term the atom. Such a ring in such a medium would be indestructible, it would be elastic, and the size of the ring and its rate of motion would constitute the differences which we recognise between the elementary substances, instead of these differences being due to the size and shape of ultimate hard particles and their impressed forces. In this view matter itself becomes but a mode of motion, and the old conception of forces as entities disappears. Everything is in the last analysis reducible to motion in the ether, and whether any given set of motions manifest themselves as heat, light, or electricity depends upon the character of the motions. The ether is at once the medium for the transfer of all motion and the storehouse of all energy. Professor Dolbear's views are, undoubtedly, gaining ground among scientific workers, and they hold out the promise of our ultimately understanding, in some greater measure than now, the ultimate structure of the physical universe.

An Instance of the "Sense of Direction"

in a wasp has been sent to us by Mr. R. Hamley Hughe, of Chingford. This gentleman had been absent from home, and on his return his wife informed him that for three days prior, a wasp had lunched with her each day. She was convinced it was the same wasp, although Mr. Hughe was somewhat sceptical. "The next morning," he writes, "just as we commenced lunch, my windows being open to the ground, in flew the wasp. My wife and children recognised it at once, and as they are passionately fond of all insects, and have no fear whatever, we allowed the wasp to do as he liked. After buzzing over each plate he settled on the leg of mutton and sawed a piece completely out of it, at a point where one cut had transversed another. He flew out with it, and returned in about twenty minutes, flew straight to where the leg of mutton had been, but finding it had gone, finally settled on a small piece which had accidentally dropped off the dish in carving. As the piece was too large for it to fly away with, it fell right over in attempting it; it held it edgeways and bit a piece out of the centre, flew away with it and then returned a third time for the remainder, each time going out of the same window and flying in the same direction. The wasp has since discovered that we also take breakfast, and has been to help himself to fish, jam, etc. The former he flies out with, but the latter is consumed on the premises."

A Sense of Personal Responsibility

is not usually accredited to animals and insects, but if we look carefully we find it an important trait among many of them. Many animals know how to impose rules of conduct upon themselves, to assign themselves duties, and to observe them. Their females attend to the wants of their young before securing their own provision of food; the sentiment of the relations of command and obedience is obvious in social animals, like monkeys, deer, elephants, buffaloes, and birds of passage. The shepherd-dog controls the flock that is intrusted to his care with as much authority and self-confidence as his master himself. The imposition of restrictions upon themselves exists among animals to the extent that is necessary for the maintenance of their health. Capacity to adapt its work to the laws of Nature is perceptible in the bird building its nest, as it is in the architect who is constructing a monument. The fox is a skilful constructor of the kind of burrow best adapted to its needs. The wasp, about which Mr. Hughe writes, was not only showing a knowledge of direction, but from the fact that most of its meal was transported elsewhere, we gather that it had a keen sense of family responsibility.

All Animals Exercise a Precise Action

upon their medium for a definite purpose. Dogs seem to have complete consciousness of their existence, and their slightest actions accord with that view. They hunt with as much ardour as men, and seem to take a genuine interest in incidents of the expedition; they prance with joy when successful, and drop their tails after failure. What right have we to deny them consciousness? The rudiments of what we regard as the real bases of personality certainly exist, in a more or less marked degree, in even the inferior animals. If man is a person and derives rights and duties from the fact, so also, to a certain extent, are the elephant, the dog, and the fox, each in its way. It is easier to talk about the gulf that separates man from the other animals than to measure it.

A New Light on the History of the Hedgehog

is thrown by a remarkable discovery in Huntingdonshire. Hitherto it has been supposed that hedgehogs fed upon roots and insects, but on several nights lately chickens had been missed from a hen roost on the farm of Mr. Upchurch, Puddick Drove, and a watch being kept, a hedgehog was discovered in the act of attacking and devouring a chicken. As it is a common practice to keep these creatures in gardens and hothouses, for the purpose of destroying beetles, worms, etc., it is a matter of considerable interest if it should be found that they do not confine their attentions to this class of food. If these statements are verified by future investigation, we shall only be able to reflect how singular it is that the habits of so familiar an animal should have remained undiscovered so long.

Three Hundred Sketches of Rain Drops

have been made by Mr. E. J. Lowe, who has also gathered some interesting facts respecting their variation in size, form, and distribution. Sheets of slate in a book form, which could be instantly closed, were employed. These were ruled in inch squares, and after exposure the drops were copied on sheets of paper ruled like the slates. Some drops produce a wet circular spot; while others, falling with greater force, have splashes around the spots. The same drop varies considerably in the amount of water it contains. The size of the drop ranges from an almost invisible point to at least two inches in diameter. Occasionally large drops fall that must be more or less hollow, as they fail to wet the whole surface inclosed within the drop. Besides the ordinary rain-drops the author has exhibited to the Royal Meteorological Society diagrams showing the drops produced by a mist floating along the ground, and also the manner in which snow-flakes, on melting, wet the slates.

Edison's Kinetograph

occasioned a lot of newspaper discussion at the time of its first announcement, but there is a characteristic want of detail in Mr. Edison's published statements on the subject, and we do not believe that he is in possession of any practicable invention for the production of a continuous visual record of surrounding objects and motions. There are few more sensational achievements promised in the existing state of science than the development of a really practicable system of kinetography. And it is with pleasure that we announce what appears to be a solution of the problem arrived at by an English inventor, and of which full details have just been published by an optical contemporary. The essential features of the invention are a photographic lens revolving continuously about its optical centre; and a curved sensitive surface subjected to such motions as cause it to enter and leave the field of view during every revolution of the lens; and to be continually renewed. When rolls of sensitive tissue are employed, as is described by the inventor, the effect is that a complete view of all surrounding objects is impressed upon a portion of the sensitive strip by each revolution of the instrument. After the development of the photographic image, it is possible to utilise the instrument as a magic lantern or megascope, for the optical projection of the panoramic view upon the walls of a circular inclosure. The working parts of the machine, which should be made of steel and aluminium, are extremely simple, and it might be given, in photographing and in projecting, a speed of about 600 revolutions per minute. Thus, for the reproduction of a "play without words," lasting half an hour, and literally surrounding the spectators with moving figures and objects, there would be required, for a lens of four inches focus, about 6,000 yards of sensitised tissue, say 2 inches wide, and costing perhaps (at one penny per foot), £75.

The Analogy Existing Between the Face and Its Members

is a pet theory with Prof. Kalmann of Basel. He maintains that there is a constant correlation between the elements of the face of such a nature that to long faces correspond high orbits (the cavity of the eye), narrow nasal apertures, and elongated palatine (mouth) vaults; and to wide faces the converse of these characters: and that the types of races expressed in head forms will be a composite of the cephalic (head) and facial indices. Prof. Sergi has now come upon the scene and arrives at quite a different conclusion. He points out from various series of skulls that in the purest types the craniological criteria vary very widely. In every race individual examples present the utmost diversity. As to any fixed correlation between the shape of the face and facial indices, which is the *crux* of Kollmann's argument, it is a pure chimera. He presents a series of measurements, tabulated from African and European crania, which leave little doubt as to the accuracy of his assertions; and Dr. Colignon, who reviews his work for *L'Anthropologie*, accepts its conclusions as incontrovertible. This is a serious blow to that department of physical anthropology which has set up a few anatomical features as more important than those of language and mind, as criteria of peoples.

GLEANINGS OF THE GLOBE.

THE first plaster cast was made by Verrochio, in 1470.

ADVERTISEMENTS first appeared in newspapers in 1652.

THE revolving pistol was the invention of Colt in 1836.

THE torpedo was the invention of Dr. Bushnell in 1777.

FLINTS for gun locks were used in the French army, 1630.

POTTER, an American boy, in 1713, made the valve-gear automatic.

IN 1800 Volta made the first voltaic pile of discs of zinc and silver.

EXPERIMENTS on animals were made with galvanism by Fowler in 1793

BEHRENS, in 1805, built the first "dry pile" of eighty pairs of plates.

NEWCOMEN, Dartmouth, built in 1712, the first self-acting steam engine.

DAVY, by the use of carbon points, produced the first electric light in 1802.

PAPIN, 1699, built an engine to run a boat. It was destroyed by boatmen.

NITRIC acid, ammonia and other substances were decomposed by Nicholson and Carlisle in 1800.

SAWDUST and shavings, reduced to powdered charcoal, are used in wine to absorb unpleasant odours.

JUST think of the millions of things in the line of inventions, so-called, not thought of, known, possessed, or required when we were boys and girls, only half a century ago. And the end has not yet begun to come.

A CORRESPONDENT of the *Lancet* recently cited a number of instances in which the appearance of influenza immediately followed the receipt of a letter from an infected place. He thinks the source of the infection was the saliva used to moisten the postage stamp.

THE rate of progression of a storm is often 50 miles an hour, and a series has been traced in a direct line from north to south, distance of 400 miles. One authority thinks that the average altitude of a thunderstorm does not extend beyond about 5,000 feet above the earth's surface.

WE published a gleaning from the *Daily News*, in a recent issue, respecting the visit of Mr. Bryce, M.P., to Mount Ararat. A correspondent, Mr. W. S. Duncan, has written to this gentleman to inquire if he really saw Noah's Ark. We are not surprised to read in Mr. Bryce's reply that "I have never claimed to have seen Noah's Ark."

ELECTRICITY is in successful use at the gun factory at St. Etienne, France, for tempering gun springs. The latter consists of steel wire, which is wound spirally, and a current of 45 volts and 23 ampères is passed through it. When the required temperature is reached, the current is interrupted and the spring falls into water. One workman can temper 2,400 springs per day by this method.

A PROCESS by which iron and steel plates can be coated with nearly pure lead is now in operation at some works in London. Hitherto it has not been possible to get lead to adhere to iron without the aid of tin, since lead has little or no affinity for iron, but in the new process this difficult feat is accomplished, the coating being effected with a bath of lead of about 98½ per cent. purity. The plates or other articles to be coated are first pickled in a bath to remove scale.

A GERMAN chemist, Dr. Gross, of Berlin, has recently been making investigations upon sulphur, and has come to the conclusion that this substance is not an element, but a compound body, consisting of a hitherto unknown substance combined with hydrogen. The alleged separation was made by the aid of electrolysis. Although it is by no means impossible, or even improbable, that sulphur is not a simple body, the results obtained by Dr. Gross need confirmation from independent sources before the compound nature of sulphur can be regarded as actually proven.

BIG men have larger heads than small men, not because their mental grasp is wider or stronger, but because their bodies are larger, and, therefore, the proportion of the head to the whole organism must be taken into account. Again, a large head may inclose a comparatively small brain, and a thick skull does not indicate intellectual force. Still further, a small brain may have a very fine quality of organism, and a large and fine brain may be imperfectly nourished. Taking all these factors into account, we want to know something more of a man than the size of his hat.

LORD KELVIN has calculated that the quantity of fuel required for each square yard of the solar surface would be no less than 13,500 pounds of coal per hour—equivalent to the works of a steam engine of 63,000 horse-power. As to the actual temperature at the sun's surface, very various estimates have been made by different computers. According to M. Saint-Claire Deville, the temperature is somewhere about 2,500 deg. to 2,800 deg. and this agrees with subsequent experiments by Bunsen and Debray. Sir Robert Ball says that "we shall probably be well within the truth if we state the effective temperature of the sun to be about 18,000 deg. Fahrenheit." The actual heat of the sun must, however, be very great.

A COPY has been sent to us of a well-illustrated and a closely reasoned pamphlet, by Mr. W. S. Duncan, M.A.I., in which the probability of the descent of man from the anthropoid apes is very fully explained and discussed. Mr. Duncan formulates an ingenious, but convincing theory, as to the precise causes and manner of the evolution from ape to ape-like man. Moreover, his argument determines the regions where, in all likelihood, the fossil remains of our mysterious ancestors, the missing links, are yet to be discovered. The object in publishing this little treatise is to awaken or stimulate practical interest in the necessary work of exploration. Copies of the "The Fossil Antecedents of Man, and Where to Discover Them," may be obtained of the author, 28, Imperial-mansions, Charing-cross-road, W.C.

SCIENCE QUERIES AND ANSWERS.

A prize of two shillings and sixpence will be awarded for every interesting question asked by our readers and published in this column, and five shillings will be given for every answer published. In all cases when identical questions or replies are sent in by two or more correspondents, the award will be given to the one whose letter is first opened, provided the subject is properly treated. Questions asked by correspondents and not satisfactorily replied to by our readers, may, if of sufficient interest, be dealt with Editorially.

Rules for Competitors.—(1) Only one question may be sent each week, but any number may be answered. (2) Write on one side of the paper only. (3) Envelopes must be marked "Science Queries and Answers," and must arrive not later than the Monday following date of publication.

The following are Answers to Queries published in No. 50.

223.—How many particles of gas are there in the whole of the earth's atmosphere?

Sir. J. Herschell has calculated the total weight of the atmosphere at eleven and two-thirds trillions of pounds, a trillion being a million multiplied three times by itself, or a unit followed by eighteen cyphers. Now one cubic foot of air weighs an ounce and a quarter; therefore in eleven and two-thirds pounds of air there are about 149 cubic feet, and as one cubic inch of air contains 3×10^{20} particles or molecules, the whole content of the atmosphere must be about 772,500 trillion $\times 10^{20}$ molecules, or, say, 8×10^{49} (8 followed by 49 cyphers).

224.—On what general lines is the national survey of a country carried out?

It is a difficult matter to carry out an accurate measurement of a perfectly straight line of considerable length; and in order to reduce to the minimum the number of such measurements required in executing the national survey of the country, the plan adopted has been to measure one line, called the base line, with great accuracy, and from each of the extremities of this to measure the angular distance between the base line and some one very prominent and distant object. These observations complete a triangle of which the lengths of the two measured sides can be calculated by a simple application of trigonometry. When this has been done then other prominent objects are selected for the apices of triangles exterior to the fundamental triangle and having for their bases one of its sides. By continuation of the process the whole country is eventually mapped out into large triangles, of which all the sides and all the angles are known either by measurement or by calculation. The subsidiary surveying operations by which the work is completed consist in the laying out of successively smaller sets of triangles *within* those already measured. Prominent trees, parts of buildings, etc., are the objects chosen for the apices of such smaller triangles.

225.—Of what use is the ophthalmoscope?

When one looks at the eye of another person an image of the pupil of the observer's eye is formed by reflection, and is seen to the exclusion of the retina of the eye under examination, which would otherwise be visible. The ophthalmoscope, by which this disability is removed, consists of a small concave mirror with a small hole in its centre, through which the observer looks from behind, while he directs a beam of reflected light into the pupil of the patient's eye. In this way, with the additional help sometimes of a divergent lens, the retina is rendered clearly visible, and many other parts of the interior of the eye can be minutely examined.

226.—Is it dangerous to drink cold fluids when in a heated condition?

The risk of contracting cramps in the stomach, etc., by the use of cold drinks when in a heated condition is probably greatly exaggerated by the popular imagination in this country. It is a common practice to take ices and iced drinks at all times and under all kinds of circumstances during the very hot weather that obtains in summer in the United States. The temperature of the body does not appear to be of very much importance in this connection, the only circumstance in which ices are particularly injurious being immediately after a full meal. In that case the flow of gastric juice and, therefore, the digestion would be interfered with by the sudden chill; and the practice, if continued, would inevitably lead to dyspepsia, more or less severe.

227.—Why does palpitation of the heart often follow indigestion?

Because of the pressure upon the heart that is exerted by an overloaded stomach distended with flatulence and food. This pressure interferes with the motion of the heart, and is a direct cause of palpitation. A secondary cause is to be found in the general disturbance of the entire nervous system resulting from the presence of an excess of undigested matter in the stomach.

228.—What is the difference between an atom and a molecule?

A molecule is the smallest particle of matter which is capable of maintaining a continued separate existence while free to obey the attractive influences exerted by other similar and closely approximated particles. An atom is, strictly speaking, the smallest particle of any elementary kind of matter that can exist in any circumstances. That is to say, an atom is an indivisible particle. The conventional chemical atom is, with few exceptions, the one half of a molecule. It is a quantity of matter that has been found capable only temporarily of a separate existence in the so-called "nascent" state. It may be the aggregate of a very large number of absolute atoms. The weight of any given chemical molecule can be approximately estimated; that of the absolute atom can only be conjectured.

QUERIES.

Replies to the following Queries must reach the Office by Monday at latest; and those selected will be published in the issue after next.

235.—How is the size of the earth determined?
236.—Why is it desirable to put a pinch of carbonate of soda in the pot when making tea?
237.—Is it injurious to drink freely at meal times, thereby diluting the gastric juice?
238.—Why does a spoon appear bent in a bowl of water?
239.—How is condensed milk made, and is it wholesome?
240.—How is static electricity produced?

The Index to Volume I

may be obtained on application to the Publishers, price 2d., post free, 2½d.

Covers for binding Vol I, price 1s., post free, 1s. 2d.

Or through any Newsagent.

THE GARRISON OF THE HUMAN BODY.

Among the topics discussed by Prince Krapotkin in an article on recent science contributed to the *Nineteenth Century*, there is one of extraordinary interest, namely, the incessant conflict going on between the micro-organisms that invade and those which defend the living body. Of all the discoveries made of late years by biologists, none is more striking than the demonstration that almost all infectious diseases may be traced to foreign bacilli, whose intrusion is resisted by a militia of resident micro-organisms known under the general name of leucocytes, the function of which is to attack, swallow, digest, neutralise, or expel the alien and noxious microbes. The outcome of this ceaseless struggle within the body is, on the one hand, health and life, and, on the other, disease and dissolution.

So far, we know more about our assailants than our defenders. Bacteriology, the branch of science which deals with the germ theory of disease, may be said to have been founded about the end of the fifties by Pasteur's researches into the fermentation of beer and wine and Virchow's investigations into cellular pathology. Since then, although some alleged discoveries have been confuted, many have been verified, and we indisputably know a great number of micro-organisms which are capable, under certain circumstances, of producing specific maladies.

For example, cholera, typhoid fever, and gastric affections generally: malaria and influenza; tuberculosis, leprosy, and cancer; diphtheria, measles, and scarlet fever; rheumatism, smallpox, rabies, and tetanus have been traced to separate microscopical beings. The photograph of each separate bacillus may be found in the text books; its modes of life, and very often its methods of reproduction, have been carefully studied, both in the animal body and in artificial cultures; subjected also to minute scrutiny have been the morbid effects which it produces when introduced into the bodies of various animals. In a word, the germ origin of infectious diseases can no longer be described as a theory; it is a fact.

Relatively backward is our knowledge of the means of combating infectious micro-organisms. Most of the specifics which once awakened hope have proved, in the long run, as ineffective against the bacilli themselves as the specifics proposed by physicians have proved against the resultant maladies. The more the study of bacteria advances the stronger is the tendency to recognise that, as sanitary measures are the most effective precautions against the risks of infection, so a healthy body which is itself capable of checking the development of morbid micro-organisms is the best means of combating them.

But what is it that permits a healthy body to resist invasion by morbid microbes? We know the invaders; but what is it that renders them highly noxious in some cases and quite inoffensive in some others? To this question cannot yet be given an answer which commands the universal assent of biologists.

The broadest and most ingenious explanation of immunity thus far put forth is the theory elaborated in 1883 by Elie Menchikoff, which represents an extension of the leading principles of the struggle for life to the microscopic constituents of the animal body. There exist in the body of man, and all vertebrates, besides the cells which constitute animal tissues, a number of free cells, the white corpuscles of blood and lymph, and the so-called wandering cells of the tissues. Four different varieties of these free cells, collectively known as *leucocytes*, have been described, the distinctions between them being chiefly based upon the shape and the numbers of their nuclei.

It appears that the leucocytes of both the higher and the lower animals have all the distinctive features of simple amœbæ. They protrude pseudopodia or feelers, and they move about, and, like amœbæ, they are endowed to a high degree with the capacity of ingesting all kinds of small granules which they find in their way, including various smaller micro-organisms. In some cases the bacilli thus ingested are *digested*, that is, transformed into a soluble matter, which is assimilated by the protoplasm of the leucocytes.

In other cases the bacteria are for some time kept alive within the leucocytes, and if the latter are placed in conditions unfavourable for themselves but favourable for the invading microbes, the invaders develop and are set free. In still other cases the leucocytes contribute to the defence of the body by driving the hostile bacteria out of the organism through the skin. Transpiration is a familiar instance of the last named process. Investigation has also demonstrated that the efficiency of the leucocytes varies greatly in different members of the same species of animal, their vigour being proportionate to the general health of the body. If the leucocytes are vigorous, they prevent the germination of the spores which they had ingested; but they maintain this power at a maximum only so long as they are healthy. If an animal has been submitted to cold, or has been narcotised, it loses its immunity from infectious maladies.

Such are the facts, and it seems reasonable to explain them, as does Menchikoff, on the theory that the leucocytes are defensive agencies against infectious disease with which animal bodies have been endowed by nature. The necessities of the struggle for existence have evolved in living organisms the capacity of self-protection by dispatching armies of leucocytes to the spots attacked by noxious microbes. The struggle, as we have said, may end in either the rout of the leucocytes, in which case disease ensues, or in the repulse of the microbes, which is followed by recovery. Or, again, the outcome may be a drawn battle, which represents the state of things in various chronic diseases.

SIFTINGS will be our title next week.

A Boon for the Brainy!

A most startling offer will be made in these columns next week. It will take the form of a financial fortune. Order SIFTINGS *early of your Newsagent, as the demand will be very great, and many may be disappointed.*

VOLUME I. OF "SCIENCE SIFTINGS"

CAN BE HAD

Bound in Cloth and Gold, 5s. Postage 6d. extra.

From the Publishers, Messrs. W. H. Smith & Son, or through any Newsagent.

A few numbers of each issue of Vol. I. (from No. 1 to 26) are still obtainable, price 3d. each, with the exception of No. 10, which is 6d.

HOW THE DRY LAND WAS SEPARATED.

Another important influence came from the centrifugal force generated by the rotation of the earth. Everyone has seen water fly from the face of a grindstone, and has noticed that the water heaps up on its equator before beginning to fly off. For like reasons the floating débris moved towards the earth's equator and formed an equatorial ring. In some cases it might remain a ring, and so perhaps it has remained in some other worlds, but in ours it did not; it was broken by the disruptive forces of which we have spoken. Then began a new process; there was a drawing together of the ring by its own attraction and that tendency to aggregation which is always seen in bodies floating freely on any liquid.

This probably occurred while the ring was yet comparatively narrow, and while a great part of the floating material had not been gathered in. At the poles the centrifugal force was zero, increasing slowly towards the equator. Hence there were probably large masses left around the poles, even after the ring had been formed. If fragments disrupted by seismic forces floated to the central mass, and chanced to strike it near its south-western and north-western shoulders, they would give it a rude triangular form, which subsequent additions might readily develop into the great triangular mass which seems to have been the antecedent of the present continental plateaus. To tell, except in a general way, just how these results were produced, is probably impossible—as impossible as to tell why a triangular cake of ice which one sees floating in a stream is not square.

This immense floating island of hardened slag had a slow westward movement, caused by the westward drag of the tides, and by the convective currents. The upper, or surface, material of the molten matter, descending from loss of heat, lost a part of its eastward motion, and hence when it returned to the surface it had, in reference to the earth, a slow westward movement, and carried with it whatever floated on its bosom.

Another fact, important in this connection, remains to be considered. For many reasons it is probable that, owing to the great pressure, a large part of the earth's interior solidified, or at least became pasty and viscid, before any crust was formed. This solid interior was not wholly at rest; there were elevations and depressions on its surface, for it seemed to be a law of nature that upward movements occur in all bodies passing through the stages of cosmic development. The irregularities in the forms of present nebulæ; the frequent upheavals in the sun; the relatively greater movements which in recent times have caused the "shoulders" of Saturn to rise more than a thousand miles; the great uprisings which have occurred on our earth since geology began—all combine to prove that vast irregular upward movements are a part of the plan of world-building. There is, then, so far as we can see, nothing to forbid the belief—but much to establish it—that portions of the solid nucleus rose above the rest, rising, in some cases almost to the surface of that fiery ocean.

We may think of that great triangular mass of hardened slag as an enormous cake of ice floating slowly westward on a river of very moderate velocity, obedient to the same laws and subject to the same accidents as any other cake of ice. If, when passing over some shallow spot, it lodged upon a shoal or elevation of small area, but too large and firm to be pushed aside, and situated on one side of the axis of the mass, the impetus previously gained, aided by the current, will cause a partial or complete rotation around the fixed point. We have seen this illustrated many times in spring, when we have stood on the bank of some shallow stream, and seen cakes of ice go swirling by.

We have watched some large one, seen it run upon some hummock, stop for a moment, and then, unable to pass over the obstacle, turn itself partially about, and break in pieces, part perhaps remaining on the obstacle, while other parts floated further on. We noted, too, that however irregular the fracture, the two sides of it were parallel, the one being the reverse of the other. The dew-drop is no more obedient to law than is the greatest sphere that swings in space: and the huge mass of floating slag, with its millions of cubic miles, obeys the laws of motion no less than the tiniest cake of ice that floats on the surface of a brook. We may then believe that if the huge triangular mass, while moving westward, chanced to strike its lower surface—to run aground—on such a shoal, situated for example, under some point south-east of its centre, the eastern portion would veer around to the northward, and would continue to move in that direction until it met some obstruction.

Inconceivably great seismic forces were at work, and from what we know of their action in historic times, we can easily believe that a crack or rift might go in a sort of zigzag line across the mass. If there are, as many suppose, lines of cleavage in the earth's crust, they offer a natural explanation of the course of the rift. We have spoken of the parallelism of fragments of ice at the moment of fracture, and until they were by some means turned more or less around. In this case, the two pieces beyond the line of separation would be floated westward; and when the north-western corner of the upper fragment—which we now call North America—came close to the end of the eastern part—*i.e.*, the extreme point of what we now call Asia, which, it will be remembered, we left moving northward—both would be brought to rest; and thus would be produced the perpendicularity of the North Pacific coasts. The lower end of North America would also be brought to rest if it struck on a similar "shoal" lying under what we now call Southern Mexico. Like causes would result in South America getting into its present position; and thus would be produced the parallelism of the Atlantic.

Given, then, (1) a solidified mass of scoriæ, (2) in form rudely triangular, (3) floating westward in the fluid lava, there would be needed (4) only three or four "shoals" on the solid or semi-solid nucleus to give, with the aid (5) of disruptive or seismic forces, the present arrangement of the continental divisions. Of these necessary conditions, the first, third, fourth and fifth are implied in the conception of a world made from molten matter, while the second—the triangularity of the floating crust—is not forbidden by any law of hydrostatics or of motion, and seems sharply indicated by the present shape and position of the fragments.

If we follow out this idea, we have a ready explanation of some otherwise inexplicable problems. The parallelism of the eastern shore of Australia and the western coast of New Zealand finds ready solution if the two were once united, and, like a field of ice in an ocean current, floated north-westwardly until, having left New Zealand fast on a "shoal," the latter fragment, from a similar cause, came to rest a thousand miles further on. Madagascar may have left Australia in like manner, and floated westwardly till brought to rest in "shallows" near the eastern coast of Africa; and thus we find a reason for the curious and otherwise puzzling fact that the eastern shore of that

island fits much better against the western shore of Australia than does the other shore against Africa.

After the fragments of the crust had been permanently "anchored," there was around them an ocean of fluid lava, destined soon to harden into the solid rock which now forms the bottom of the present oceans. We cannot agree that the surfaces of those plateaus and of the intervening seas of melted matter were once on a level. The difference between the specific gravity of the floating slag and the magma from which it was formed forbids it. The future ocean beds were even then deep depressions, ready, when sufficiently reduced in temperature, to receive the waters which were stored as an immense atmosphere of superheated steam, or in their dissociated elements. It follows as a corollary from the theory which we have offered, that the land and sea have never changed places. Not very long ago this would have been thought a fatal objection, but now, so far as it goes, it strengthens it.

Through some such process as we have described, we can but believe the grand features of our planet were wrought out. After that, the cooling still went on. The bottom of the ocean basin at length ceased to glow; the reduced temperature permitted the hitherto invisible superheated vapour to take visible form as clouds, or to descend in torrents, to be again and again flung back by the still hot surface. As the conflict went on, the oceans gradually filled up, until at last the water not only filled the basins, but spread over the continental plateaus, covering them all. As the years passed on, the hot seas grew cooler; life became possible, and, in its humblest forms, was introduced.

The rest of the story of the continents is found in a book whose leaves are rocks, and whose characters are fossils. Geologists are reading it for us.

(*Concluded from last week.*)

SIFTINGS will be our title next week.

THE HUMAN EAR.

Few people realise what a wonderfully delicate piece of mechanism the human ear really is. That which we ordinarily designate as the "ear" is, after all only the mere outer porch of a series of winding passages which lead from the world without to the world within. Certain of these passages are filled with liquid, besides having membranes stretched like parchment curtains across the corridor at different points. When a sound wave strikes these they are thrown into vibrations and made to tremble like the head of a drum does when struck with a stick or with the fingers. Between two of these parchment-like curtains a chain of minute bones extends, which serves to tighten or relax the membranes and to communicate vibrations to them. In the innermost place of all, a row of white threads called nerves, stretch like the strings of a piano from the last point from which the tremblings reach, passing thence inward to the brain.

OUR EXCHANGE AND MART.

The "Sale and Exchange" Column will be found on page ii. Our rates are lower than those of any other paper, and an advertisement of a scientific nature in this column will come under the notice of at least 50,000 possible buyers.

HUMAN ELECTRICITY.

The investigations of physicists make it highly probable that all movements of matter, even those of a molecular character, are linked with electrical phenomena. Our modern methods of producing electricity by friction, by induction, by heat, by chemical action, are but specially contrived imitations of processes carried on throughout the ages.

Such considerations would naturally lead one to expect that electrical phenomena would also be associated with those finer molecular changes on which life depends, and that it is only a matter of experimental detail to demonstrate the existence of an animal electricity. It seldom, however, happens in science that we see far before us. When we look backwards, the light irradiates the way we have come, but pressing forward, we discover new facts only by stumbling on them.

All this is true of animal electricity. Electrical fishes have been known from very early times. But it was not until 1773, Professor John McKendrick has pointed out in the *Fortnightly Review*, that Walsh first demonstrated that the shocks of the torpedo were truly electrical. Thirteen years later Luigi Galvani noticed that the limbs of recently killed frogs became convulsed when brought near a frictional electric machine in action. This famous observation marks a new era in the history of science.

All the world knows that the famous controversy between Galvani and his followers led to the invention of the voltaic pile in 1799, and still more to the discovery of the production of electric currents by the contact of dissimilar metals, more especially when one of them is acted on chemically by certain fluids. For a long time the brilliancy of the results flowing from the investigations into voltaic electricity threw the discoveries of Galvani into the shade; but, by-and-bye, as experimental methods became more delicate, it was found that there is, in truth, an animal electricity, the existence of which was doubted by Volta and his followers.

The researches of Nobili, in 1825, showed that Galvani was right as to the existence of an animal electricity, but wrong in holding that the contact of two metals with the tissues afforded proof of it. Mattenci, about 1837, enriched the subject by many beautiful investigations, and by joining the thighs of frogs in a special way he made a living voltaic pile, which produced effects similar in character to the piles built up by physicians with discs of metal and intervening discs of paper or cloth. Then came Du Bois Raymond, whose researches have advanced the subject another and an important stage.

The existence of electrical phenomena in living structures is now demonstrable by means of a sensitive galvanometer, or the ingenious capillary electrometer invented by Lippman in 1873. By connecting tissues with the unpolarisable electrode of Du Bois Raymond it can be shown that all living tissues show differences of potential at different points, or, in other words, that electrical currents pass through the instruments when the tissues are placed on the electrodes.

In the case of muscles, the strongest current is obtained when one electrode touches the centre of a transverse section, while the other touches the uninjured surface of what may be called the equator of the muscle—that is, a line encircling it in the middle of its length; and it can be shown that the surface is always positive to the transverse section. But the case is different when the tissue or organ discharges its normal function. This will be readily understood, Pro-

fessor McKendrick thinks, if we examine what occurs in a contracting muscle.

The normal function of a muscle is to contract. Now, suppose a muscle laid on the electrodes so that a "resting" current is manifested by the deflection of the needle of the galvanometer; let the nerve supplying the muscles be irritated so as to cause contraction of the muscle; instantly the needle of the galvanometer moves in the opposite direction, and may pass even beyond the zero point. This is due to the generation of a new current in the muscle, in a direction opposite to that of the resting current. The proof is this: Let us compensate the resting current before causing contraction of the muscle by sending a portion of a current from a Daniell's element in the opposite direction so that the galvanometer is brought to zero; then cause the muscle to contract, and the new current,—the action current as it may be called,—sends the galvanometer needle to the opposite side of zero. This is a vital phenomenon, which can occur only when the muscle is alive.

Electrical phenomena may also be discovered in the central nervous organs. If we bring the electrodes of the galvanometer into contact with the surface of the brain, electrical changes occur when light falls on the eye. Recently Gotch and Horsley have explored the spinal cords with electrodes connected with the capillary electrometer and have found electrical variations in the motor strands of the cords, when motor centres in the cerebral cortex were irritated. Thus in a sense they tapped the wires of the living telegraphic system, and got information as to the paths in the cord along which motor, and even sensory, impulses travel.

It seems to be only a matter of experiment to discover electrical changes in all the cerebral nervous organs. Could we picture to ourselves the changes in the brain when its higher centres are in a state of molecular disturbance, as when one is thinking rapidly in a lecture, now adapting his words to his ideas, now thinking ahead as to what he will say next, now noticing the effect of his words on the audience, now becoming conscious that he is obscure, and again that he is succeeding in making things plain, now watching the clock and noting the inevitable flight of time—could we, in such circumstances of mental turmoil, examine the phenomena of the brain, we would, in all probability, obtain evidence of rapid changes of potential, and of currents flashing in a thousand directions, pursuing paths more intricate than would all the telegraphic and telephonic wires in London, if they were concentrated in one vast exchange. Professor Houston's hypotheses on cerebration, recently published in SCIENCE SIFTINGS, are of extreme interest in this connection.

SIFTINGS will be our title next week.

AT one period during the building of the Crystal Palace some 7,000 workmen were engaged in its erection, and some idea of its vastness may be obtained from the fact that 9,642 tons of iron were used in the framework, besides 175 tons of bolts and rivets, and 103 tons of nails. Were it possible to place the panes of glass employed end to end they would be found to extend 242 miles. For heating purposes alone there are fifty miles of piping under the floor, and ten miles more of pipes carrying the water supply to the fountains. When the complete fountain system is in full swing, as many as 11,788 jets are playing, and throwing 120,000 gallons into the air every minute. One great display consumes 6,000,000 gallons of water.

CONSTRUCTING CONSTITUTIONS.

The instincts of healthy children should certainly be permitted to have weight as regards their diet, and this is perhaps especially true as to the quantity of food they require. A healthy, well-born child is probably a better judge of the amount of food it requires than its parent. We do not arbitrarily stop a baby nursing when it is eagerly devouring its meal, for we have learned that when it has become satisfied it will cease to eat of its own accord.

Instinct must certainly be relied upon, but we must remember that children are not ideally healthy, and that because they and we are so far from nature we must have recourse to science for help in this as in other subjects.

As regards quantity, then, we must bear in mind that a child requires relatively more food than his elders, for obvious reasons. The parent has certain brain and muscular work to accomplish, the power for which comes mainly from his food. He must also maintain his bodily heat, and this he is constantly expending in work as well as in radiating from his body. This heat and these losses must be made good by food. But the child of the school age, from 7 to 14 years, must not only do all this but much more. He must not only hold his own, but must daily add new material to his little body, and lay up a plus balance to meet the demands of his rapidly growing organism.

Children suffer more during famine than adults, and it is probable that with them more danger is incurred by underfeeding than by overfeeding. They certainly require an abundance.

Of what shall this abundance consist? What shall the growing child eat?

If we were to analyse the constitution of our food in general, we should find that we eat nitrogen, and carbon, and hydrogen, and phosphorus, in various forms, as well as iron, and soda, and potash, with other minerals in proportions that vary with the kind of diet we adopt. And we have very good reason for believing that some of these food stuffs contribute more directly than others to bodily energy, and that this energy may be increased or diminished by giving or withholding certain of these elements.

When, for instance, a man is training for a boat race—an effort calling for muscular exertion, as well as nervous endurance—he lives largely upon meat, a nitrogen-supplying food. When he has to endure great cold he seeks fatty food—carbo-hydrate food, as evidenced in the Eskimos and other dwellers in Arctic regions.

What are the physical requirements of the growing child? He is developing bone and muscle at an enormous rate, and all of his internal organs must keep pace with this general growth.

His height, for instance, which means the growth of his skeleton, increases on an average from $1\frac{3}{4}$ inches to 2 inches per year up to the age of 12, and for the succeeding two or three years (longer for a boy) he may increase in some cases from 3 to 4 inches. His weight gains 4 to 10 pounds yearly, in some cases more than this. He is making brain, too, as well as using up nervous energy all of this time.

Now, while all the food-stuffs that we eat have a general relation to growth and nutrition, certain elements have a peculiar adaptability to building up special tissues. Lean meat offers one of the most digestible and concentrated forms of obtaining nitrogen, which it contains principally in the form of albumen, and nitrogenous food especially

promotes muscular as well as nervous energy, and the energy obtained from this food appears to be liberated more quickly than from other stuffs. It is also believed that such food has special influence in forming red blood cells. Albumen (nitrogenous food) is not, however, by any means confined to animal food. Certain grains contain a large amount of nitrogen, as do also some of the leguminous foods, such as peas, and beans, and lentils.

Milk contains nitrogen in the form of albumen and casein. So that both as a digestible and a highly nutritious food it should be included in the dietary of the growing child.

But besides energy we must furnish heat, and while this, it is true, is gained by the interworking of all the organs, and by the chemical activities constantly going on within us, so that all kinds of nourishment may help to furnish the heat required, yet it is true that fat is the food that is most useful in this respect.

The heat forming qualities of fat are nearly double those of lean meat, for while a pound of lean meat, if oxygenated, will yield heat enough to raise over 4,000 pounds of water one degree centigrade, the same quantity of fat will raise over 9,000 pounds of water to the same point. So we can see how much more economical in cold climates is an admixture of fat with lean meat for heating purposes merely. But fat is useful for other reasons, and we judge it to be a very necessary article of diet from its forming so large a proportion of some of the most important tissues of the body—namely, the nervous—the brain containing 8 per cent. of fat while the nerves contain 22 per cent. It must not be understood that fat in the tissues is made directly from fat in the food: on the contrary more fat is continually being manufactured in the body than can be accounted for in the food. One use for fat is believed to be as a protector of the albumen, which is less rapidly used if fat be taken with it, and practically we see every day the value of administering fat to children of our climate and national temperament, and the harm that may result from withholding it.

A distinguished English physician once said that the two great causes of tuberculosis were the dearness of butter and the abundance of pastry cooks. It is a well known fact that children are frequently chided for eating too much butter on their bread, when the real reason of the denial is not its unwholesomeness, but its expense, and when their own instinct for the food which they need is every day shown to be in that respect a natural and healthy one.

It is well proven that in scrofulous affections, as well as in pulmonary tuberculosis, the use of fat in the form of cream, olive oil, butter, or cod liver oil, is attended with the best of results, and forms, indeed, an important prescription with every experienced practitioner. These fats are also commonly given in nervous exhaustion with the happiest results.

These and similar facts certainly indicate that this form of a carbo-hydrate element may well be used to prevent as well as to cure these constitutional tendencies. We believe, in fact, that many of our thin and pale children who have tendencies to colds and sore throats, and many others who are irritable, would be greatly benefited by the continued and judicious use of fat in some digestible form, such as fat bacon, the use of cream on bread or baked potatoes, as well as by a bountiful supply of good butter. All of these fats will be more digestible if well subdivided, hence we spread butter on our bread and may use bread crumbs or potatoes with fat bacon. Chocolate or cocoa is also useful for a fat provider.

But these highly nutritious articles must be mixed with less concentrated food or the digestive organs will be overtaxed, and so we must give the children starch, which is another form of carbon. Rice, potatoes, and refined flour, are good examples of this food stuff. The proportion that starchy food should bear to albumen and fatty foods is much greater in the diet of an adult than in that of a child. An adult takes about three times as much starchy food as of the other two combined, but a child requires more of the albumen and fat, proportionately, and therefore somewhat less starch than the above.

Too many children receive an excess of starchy and too little albuminous and fatty food, and this diet tends to induce anæmia, to form bone poorly and to reduce nerve strength.

How many children, for instance, are allowed to make an entire breakfast upon food, which contains hardly a vestige of nitrogen, or muscle-makers, and very little of other most important nerve foods, and on this poor meal the child must study the whole morning. Not infrequently he is too tired on returning home at luncheon time to eat the chop or steak provided and perhaps satisfies his appetite with baked apples and gingerbread. Such food will not make brawn and brain for our children.

SIFTINGS will be our title next week.

DOCTORS' BLUNDERS.

Dr. Lauder Brunton, in a recent address, laid great emphasis on the necessity of care in diagnosis, and gave some amusing instances of errors in this important part of a physician's work, due to too hastily formed opinions. In one case he was among a class of students around a man suffering from heart disease, when it was noticed that the pupil of one eye was much more dilated than the other. At once numerous more or less learned suggestions were made to account for the mydriasis. Eventually the man informed them that the eye over which there had been so much animated debate was a glass one. Another instance related to a learned professor who used to boast that he could tell much concerning the medical history of his patients by their teeth. When holding forth on his favourite theory one day, he was considerably disconcerted by the patient taking out the complete set of masticators, and saying: "Perhaps the gentleman would like to look at them closer."

A BLIND MAN'S PERCEPTION.

By some singular instinct, says an exchange, a man who was born blind can tell when he is opposite an object, and can tell whether it is tall or short, slender or bulky. He can also determine whether it be a solitary object or a continuous fence; whether a close fence or an open one, and sometimes whether a wooden fence, a stone wall, or a hedge. None of the five senses has anything to do with this perceptive power, says our contemporary, but the impressions are made on the skin of the face, and by it transmitted to the brain. This unrecognised sense is called "facial perception." The presence of fog interferes with facial perception, and makes the impression faint and untrustworthy, but darkness is no impediment. A noise which distracts the attention interferes with the impressions. In passing along the street such a blind man can distinguish shops from private houses, doors from windows, and whether the windows consist of a number of panes or a single sheet of glass.

AFRICA'S PIGMIES.

Andrew Battell, an English prisoner in the hands of the Portuguese, distinguished himself for two discoveries, over 250 years ago. He was kept for years in the convict colony of Angola, on the west coast of Africa, and had an opportunity while living there to travel much in Angola and the adjoining regions. He was the first to make known the existence of the gorilla, the most remarkable among African animals; and he was also the first to announce, in comparatively recent times, the existence of dwarfs—"little people called Matimba, who are not bigger than boys of twelve years."

There is no doubt that Battell discovered the ancestors of the Obongo dwarfs whom Du Chaillu brought to light again in 1865; and it is interesting to note that the world, determined not to accept dwarfs as an anthropological fact, rejected Battell's discovery in the seventeenth century, just as it more than half rejected Du Chaillu's in the nineteenth. This is one instance among many of important discoveries in Africa discarded by the early geographers; and not a few recent explorations have merely been rediscoveries of facts that were well known 200 or 300 years ago, and that were later expunged from the maps on flimsy pretexts by men who did not know as much as they thought they did.

Forty years ago no one supposed that tribes of dwarfs existed in Africa. To-day authorities like Schlichter, Felkin, and others affirm not only that the ancient writers were dealing with fact and not fable when they wrote of the dwarfs of Central Africa, but also that the world derived important geographical facts from these dwarfs. They believe, with Captain Stairs, that dwarfs found their way in ancient times into Egypt, and that they doubtless gave some information about the "Mountains of the Moon" and the sources of the Nile.

The theory that dwarfs from the Upper Nile regions did reach Egypt is fortified in a striking manner by the recent discovery on an old Egyptian monument of the picture of a dwarf with the name of Akka beside it, which is the name of the most famous of the Central African dwarf tribes; but later centuries had no faith in dwarfs tribes, and the testimony of more than one recent discoverer was needed before the interesting subject attracted much attention. Some fifteen explorers have within the past few years added many facts to our knowledge of the dwarfs, and though our acquaintance with them is still incomplete, enough facts have been obtained to enable us to take a general view of these curious little people.

One group of these pigmies, the Dokos, have not yet been visited by any explorer, and yet it is certain they inhabit the region south of Abyssinia. It is hoped that before long some explorer will visit them in their home and tell us more about them. Avanchers, Krapf, and d'Abbadie, all travellers of authority, have met many of them, and independently of one another have borne testimony to their existence. They were described by these men as having the same characteristics that mark the equatorial dwarfs who were not known for years after the Dokos had excited the curiosity of ethnologists. Prof. Hartman in 1876 collected on east coast reliable reports about the Dokos, confirming the earlier reports.

The Dokos are said to be dark brown in colour, extremely ugly in physique, and about four feet high. They go entirely without clothing, and build most primitive huts, which they cover with skins or leaves. Their only occupation is hunting. They change their quarters as soon as game becomes scarce, use only poisoned arrows, and they are expert in catching animals in traps and pitfalls. They do not know the use of fire, and eat the flesh of serpents and other animals raw. Dr. Henry Schlichter, who has collated all the evidence at hand relating to these perfect savages, says that, although their country has never been visited, it can safely be said that "east of the Nile and to the south of Kaffa in the unexplored territories to the south of the River Omo there exists a pigmy race similar in size, appearance, and habits to the dwarfs of the Upper Nile and Congo regions." It is probable that they are scattered among other tribes of different race and customs, like their relatives in West and Central Africa.

It is now possible to divide the dwarfs of Africa into four groups—the pigmies of West Africa, known as the Obongo, Akoa, and Babongo who were first met in recent times by Du Chaillu; the dwarfs of the central regions, known as Akka, Wambutti, and Batua, discovered and described by Greenfell, Von Francois, Lenz, Wolf, Wissmin, and others; the East African pigmies, known as Dokos, though they probably compose several tribes speaking different dialects; and the dwarfs south of the Congo basin who are the bushmen and their relatives of South Africa. Some time ago Mr. Haliburton reported the discovery of dwarfs among the Atlas mountains of Morocco, but the reports about these alleged pigmies are not yet sufficiently authenticated to be accepted as fact.

Among all these widely separated dwarf tribes exist resemblances so striking that these little peoples are now believed to be branches of the same great family that by one great cause or another was separated, perhaps centuries ago, until to-day its parts are divided by hundreds of miles of territory in which no dwarfs are found. They are all migratory, never remaining long in one place, though they do not often wander far out of their own district. Although all of them are savages of the very lowest type, their cunning and skill as hunters are most remarkable. They live among tribes of ordinary stature whom they supply with dried meat and fish in exchange for vegetable food, knives, and other articles.

They intermarry only to a small extent with their larger neighbours, and, as a rule, are very shy in their intercourse with other peoples, which accounts for the fragmentary information we at present possess about them. Beards are developed among them more largely than among other African tribes. All of them excel their larger neighbours in dexterity as archers, in nimbleness, and in ingenious devices for catching game. Every school boy has seen pictures of Native Africans disguising themselves in ostrich skins to get within bow shot of these shy birds. It is only the dwarf bushmen who practise this device. Livingstone said that the dwarfs he met killed many lions with their insignificant looking arrows. We know very little as yet about their languages and dialects, but the incomplete vocabularies that have been collected show that not a few of the words of these widely severed tribes are identical. On the whole it may be said that the differences between these tribes are of much less significance than the resemblances between the groups, and Schweinfurth is doubtless correct in saying that where the general similarity is so great all minor discrepancies sink into insignificance.

In a number of respects, however, the various dwarf tribes show differences of some importance. In Central

Africa the Tikki-Tikki dwarfs are a little taller, have darker skins, more vigorous limbs, are covered with fewer but coarser hairs than the Akka who live a little north of them. The Akka, on the other hand, are a little taller than the Obongo in West Africa. The average height of adult men among the Obongo is 4 feet 3 inches, while the average among the Akka men is about 4 feet 7 inches. The Obongo are probably the smallest dwarfs in Africa. The tribes differ in colour from light brown to black. Beards are a feature of all the dwarf peoples, but are scantily developed among some of them, while among others the beard is quite long, particularly among the Batau south of the Congo.

The dwarfs of the central regions, the Akka, Wambutti, Tikki-Tikki, and Batau form the most important group of African pigmies. They are all warlike, and few of the tribes around them have given explorers so much trouble as the little folks who have dogged their caravans, skulking in the forests or jungle where they can scarcely be seen, climbing trees and swinging themselves out on the limbs with the agility of monkeys, and from this vantage place showering down poisoned arrows upon the enemy below. Explorers tell of the Batua swinging from branch to branch as trapeze performers take flight from one bar to another. Grenfell and Von Francois were astounded to see the Batua scramble out on boughs overhanging the rivers until the limbs bent low beneath their weight.

These Batua tribes extend over the whole southern part of the Congo basin, and doubtless much additional information about them will be brought home by future explorers. Very little is known of them at present, except the fact of their existence. Schlichter says that, like the Akka and the Wambutti, their intercourse with the various tribes of ordinary stature among whom they live is usually of a friendly nature, partly because the Batua tribes are afraid of them and partly because the pigmies supply these tribes with flesh and skins in exchange for vegetable food, cooking pots, and other articles that may be regarded as among the luxuries of African pigmy life. Moreover, they are thoroughly at home in the forest, and are, therefore, valuable to their Batua friends as spies and scouts in times of feuds and warfare.

The sites of their encampments and villages are always carefully selected to prevent surprise, and Stanley describes their daily life as being similar to that of the Batua population among whom they live. The women do all the domestic work, erect the beehive huts, collect wood and vegetable food, watch the fires and dry the meat. The men spend most of their time in hunting or in bartering with neighbouring tribes. They usually speak the dialects of their neighbours, but all travellers say they also have a distinct language of their own of which we have as yet very little knowledge.

Serpa Pinto describes the dwarfs he met in the Aubuella country as the most complete savages he ever met. They are regarded as the connecting link between the dwarf bushmen further south and the more northern dwarf tribes. Living in the forests between the Cubando and the Cuando rivers they speak a language of their own which is unintelligible to other surrounding tribes, know nothing of agriculture, have only bows and arrows as weapons, erect no dwellings but live in encampments where branches of trees, bent downward and interlaced in front, constitute their only shelter.

The bushmen south of them live in caves or inhabit temporary huts of bushes or sticks set up against each other and covered with grass, grass mats, or brush wood. Like the other dwarf tribes, they do not live long in one place, and their chief means of subsistence are the products of the chase and the roots and fruits of the desert. Separated far from their northern relations, they strikingly resemble them in many respects.

It is now very generally believed that all these dwarf tribes are the remnant of the original population of Africa, who, many centuries ago, were decimated and widely scattered by the intrusion of stronger peoples. While there is no direct evidence proving this hypothesis, there are circumstances that give it much strength, and among them is the improbability that the various scattered pigmy tribes could have immigrated into territories already occupied by the Batua, Nuba, and Hottentot races.

SIFTINGS OF THE STUDY.

Publishers sending books for review are requested in all cases to state the price of the work.

The Visible To-Be : A Story of Hand-Reading.

(London : The Leadenhall Press, Limited.)

This book is, on the whole, somewhat disappointing as a work with any pretensions to science, although as a novel, it affords light and fairly pleasant reading. The authoress (for its dedication is obviously feminine) has very discreetly, we think, veiled her identity. We say discreetly, not because of any pronounced faults in its literary matter, but owing to her pretensions to almost unerring skill in chiromancy. Such pretensions borne out by the conveniently accurate sequels that are made to develop themselves throughout the work, would, undoubtedly, were the identity of the writer disclosed, have brought solicitations innumerable for the " reading " of the palms of the ignorant and the superstitious. The book is one series of the convenient method of making fact agree with theory, and although the work may serve to while away a lazy half hour, we regret that its mission is one calculated rather to retard than to assist mental progress and enlightenment.

Keep your Mouth Shut.

By Fred A. A. Smith, M.D.C.M., Glasgow.

(London : Baillière, Tindall, and Cox.)

Dr. Smith has treated the subject of this *brochure* in a thorough and yet popular manner. He advocates so strongly and conclusively the necessity for breathing through the nostrils only, that those who read the book are bound to be convinced of the dangers of breathing especially in this climate, through the mouth. The book is addressed particularly to mothers and those having the care of children, and we can heartily recommend it as a work of no little importance. The book is published at the low price of 1s. 6d.

A Text Book of Agricultural Entomology.

By Eleanor A. Ormerod, F.R.Met.Soc., etc.

(London : Simpkin Marshall.)

The authoress of this book in her preface states that the work is offered as " a guide or means of leading the student onwards to a knowledge of some of the fixed laws of insect life." A perusal of the work fully bears out this promise, and we find it one of the most succinct works on agricultural entomology yet published. It appears to be primarily

written for the agriculturist, and to him the book, with its descriptions of many of the insect pests and means for their prevention and destruction will be literally worth its weight in gold. To the student of general entomology also, the work, with its complete descriptive matter and many illustrations, will prove of absorbing interest.

TO STRENGTHEN THE THROAT.

Sir Morrell Mackenzie always insisted that a great many of the ailments that were brought under his notice could have been escaped but for injudicious codling of the throat. The throat must not be wrapped up too much; the great thing is to try to harden it. By care and persistence the neck can be made as weather-proof as the face. Many people who are not in the secret are amazed that the patriarchal Gladstone can stand for hours with head uncovered in the open air while a strong breeze is blowing.

The ability to do this with impunity was gained by sitting habitually at a window through which a draught was created, so that the head became accustomed to all variations of temperature and all degrees of air motion. In the same way the throat can become habituated to varying conditions. It should be kept free from wrappings. Women should dispense with their great feather boas and Medici collars, and men should cast aside their stifling mufflers. It is an excellent practice to wear turn-down collars, and gargling with cold salt and water in the morning has sovereign virtue, as well as bathing the throat first with very hot water and then with cold. The throat thus receives a sudden shock and is braced up and permanently strengthened.

SIFTINGS will be our title next week.

THE NEW STONE AGE IN ICELAND.

According to a lecture before the Society of Arts on "Iceland," by Dr. Tempest Anderson, in the more remote parts of the country, such as the Skaptadals, many articles of bone and stone are still in use which in more accessible districts have been replaced by metal or earthenware. A photograph exhibited showed a wheelbarrow with a stone wheel, a steelyard with a stone weight, a hammer with a stone head, and a net with stone sinkers. At the same farm a quern, or stone hand-mill, was in use, and also horn stirrups, and harness fastenings of bone instead of metallic buckles, bone pins, and rude bone dice. At a neighbouring farm was a basin formed of the cup joint of a basalt pillar. Truly we still have a survival of the stone age. Less remote than this is the meeting-place of the County Council of the district in a spacious cave in the lava. It would be difficult to find anything more appropriate in such a primitive land. Mr. E. Magnusson, speaking on the author's address, said that in some places the people, though descended from those who had long left the stone age behind, had found it necessary, because it was so difficult to procure iron, to create a new stone age for themselves. They were the creators of a new stone age, not the followers of a tradition.

If you have an idea for a patent, write to the Editor of SCIENCE SIFTINGS, giving the outline of your scheme. The communication will be treated confidentially, and an expert will give you the fullest information as to the manner in which to proceed.

SOCIAL SCIENCE.

SOCIAL REFORM.

All actual and permanent expansion and integration of society proceeds from the voluntary co-operative action of individuals. Affection and self-interest are the attractive forces, which bind society together, and these forces are consciously directed and made steadily operative solely by individual volition. Therefore, it is that in its psychical aspect—the aspect directly involved in all measures of social advancement—society is subordinated to the individual, the structure to the unit, instead of the reverse, as in the evolution of animal and vegetable organisms.

The social reformer, therefore, who would work in harmony with the tendencies and laws of nature must direct his efforts towards convincing the judgments and influencing the motives and moral natures of individual men and women, rather than towards forcibly changing the customs of society by legal enactments, official pronunciamentos, or majority votes under the white heat of an emotional political campaign. It is strange that our social reformers, who advocate the cure of societary ills by legislation, and the paternal control of the Government over the affairs of the individual, do not see that men and women must first be personally convinced of the utility of such public arrangements as they advocate, with substantial unanimity, before legislation in their behalf could possibly be effective; and when the practical unity of sentiment has been wrought out in the community which would insure the enforcement of the law, the law is really no longer a necessity.

In other words *voluntary consent* is the essential condition of all stable social arrangements, instead of governmental coercion. The object of the social reformer should be not only to accomplish the renovation of society, but to do it in the quickest possible time in which it can be so accomplished that the changes effected shall be permanent, and the trend of social evolution shall surely be directed toward the ideal of individual enlightenment and liberation and social integration. These ends can be surely accomplished by the method of evolution, and it should be the purpose of the wise social reformer to build along the great lines of natural evolutionary tendency, and thus to make use of those elemental forces, social, moral, and biological, which will insure stability and permanent prosperity for the results of his efforts.

The processes of social differentiation go hand in hand with the tendencies to social integration. As occupations become more diversified, the individual acquires greater skill in his special vocation; he produces a greater amount of wealth, and so conduces more to the well-being of society, as well as, under a properly regulated system of labour, to his own personal well-being. Fewer hours of labour are requisite to secure a livelihood, as labour becomes differentiated and automatic; more time may be bestowed upon general culture, social intercourse, and the service of the common wealth—upon the development, in short, of that fulness of life, which constitutes the ideal of a perfect manhood.

In wisely serving himself the individual is rendering a greater service to society; and this in turn, inures to his own roundabout development. Egotism is thus purged of its excesses, and made to promote the general well-being. In the proper equilibration of egotistic and altruistic motives in the government of conduct, all conflict between these

motives ceases. In wisely serving his neighbour, man renders the truest service to himself, and vice versa. Thus society integrates by a natural process of growth, obedient to laws which are operative in the evolution of all living things; and its ultimate form constitutes a real brotherhood of consent, instead of a militant organisation consolidated by external coercion.

TOBACCO KILLS THE CHAMELEON.

Dr. Tristram Pruen, in his book, "The Arab and the African," says:—"Chameleons are far from uncommon: but they stand so motionless on the twigs amongst the foliage, and adapt their colour so rapidly to their surroundings, that only an experienced eye discovers them. The rapidity with which they change colour is very surprising. I have seen one change in less than a minute from a yellow and brown to a most delicate transparent green, exactly like the young leaves of the banana tree on which it stood. The natives told me that tobacco juice would kill the chameleon almost instantly. I expressed incredulity; whereupon they gave one a little piece of tobacco which they had fixed on the end of a stick, and heated in the fire until it exuded its sticky juice. The chameleon snapped angrily at the tobacco, and then marched on slowly as if nothing had happened—a fact which I pointed out to the natives. 'Wait a little, master; wait and see,' they replied. The chameleon had hardly gone twenty steps when it began to stagger, stopped short, and then gradually began to shake all over, as if it had a violent attack of St. Vitus's dance. Slowly its sides sank in, its limbs were drawn towards its body, its tail curled up, and it fell over on its side, dead."

PERPETUATING YOUTH.

In this great world of moral and material wonder, where there is so much of beauty, of grandeur, of mystery, of struggle, of noble effort, of pitiful failure, of magnificent enterprise, of fascinating discovery, so much to love, so much to admire and to revere, so much to help forward, so much to fight against and subdue—in this world, which we believe is the training ground of our souls for nobler, and higher, and less encumbered work hereafter, in this quasi-childhood of our real lives—why should we not try to keep our souls as open to new impressions in our riper years as in the days of our youth? It is not years that make age. Frivolous pursuits, base passions unsubdued, narrow selfishness, vacuity of mind, life with sordid aims, or without an aim at all—these are the things that bring age to the soul. Healthful tastes, an open eye for what is beautiful and good in nature and in man, a happy remembrance of youthful pleasures, a mind never without some active interest or pursuit—these are things that carry on the feelings of youth, even into the years when the body may have lost most of its comeliness and its force.—Sir Theodore Martin.

HELPFUL HINTS.

This column is intended to help our readers, by answering reasonabl questions, and by recommending, when requested, the most suitable modern scientific works for reading and study.

The Discovery of Gravitation.

Appleby King.—The passage that you quote from Shakespeare is certainly of considerable interest in this connection.

"But the strong base and building of my love
Is as the very centre of the earth—
Drawing all to it."

It gives an indication of the possession by the poet of the first link in that chain of reasoning by which the great discovery of universal gravitation must have been arrived at. Too much importance may, however, be easily attached to the mere recognition of an attractive influence apparently exerted by the centre of the earth. It should be remembered that the *mutual* attractiveness conferred upon all material bodies by gravitation, together with the variation of its intensity with the square of the distance, and the application of these facts to the explanation of celestial motions, are the essentials of Sir Isaac Newton's discovery.

Astronomical Observations.

W. Sidney Mayne.—The stars can not only be seen but may be examined telescopically in an ordinary looking glass placed horizontally. If the looking glass were curved so as to give the effect of a concave mirror you might possibly obtain an increased intensity of illumination that would more than make up for what is necessarily lost in the act of reflection. Your observation that you report to us must, however, have been erroneous. It is quite impossible that the satellites of Mars can be discovered in the way you describe.

Index to Vol. II. "Science Siftings."

Lawrence Munden.—The index to our second volume will be published about the 18th inst. An announcement respecting the exact date will probably appear in our next issue.

Miscellaneous.

Well Wisher.—Some of our advertising contracts are made so r ahead that any immediate and radical change, such as you suggest, in the arrangement of the paper, would be impossible. It is, however, an easy matter for the binder to remove the last page of the paper as well as the cover, and when this is done practically nothing but reading matter remains.

A Searcher after Knowledge.—We do not agree with you that the employment of the metric units of measurement is objectionable in a popular science paper. It is a very simple matter to learn the metric terminology. And such is the facility with which calculations can be made on this (decimal) system, that we think all should endeavour to do their share, by employing it when convenient, to hasten the prospective legalisation of this system of weights and measures as the only standard within the United Kingdom, as it is already in a large majority of the civilised countries of the world.

Hampton.—The description you send refers to the effect of a cyclone or whirlwind. Its occurrence in this country, as related, would appear to be very remarkable.

Criticus.—Thanks for your letter and the trouble you have taken. It would be of interest to hear what Mr. Bryce himself has to say in explanation of the well authenticated and plausable report published on page 298. See "Gleaning" just received, page 354.

W. S. Brown.—*Re* divining rod, p ease see reply to Mr. J. Allen in our last. In accordance with your witty observation, we have been, so to speak, "getting into harness," and we have sufficient horse-power to demolish the institute.

New Reader.—(1) We believe the claims made for them to be quite genuine. (2) Send it to us, inclosing postage for return, and we will test it free of charge.

W. S. Duncan.—Thanks for your communications and the trouble you have taken. See paragraph under "Gleanings of the Globe."

W. A. McGillivray.—Your proposal amounts to the publication of a complete technical course of every branch of science. It certainly commends itself to us, but for the present, for various reasons, we are unable to adopt it.

M. K. (Fenwick).—You greatly wrong us, the fighting is only now about to commence. Not in our columns, however, but in a court of law. We have brought him to bay, and that is all we expected to do. The rest will follow.

J. Morris.—Mr. W. McQuhar's "Practical Technical Instructor" may be obtained by addressing the author at Cockermouth.

Charles Fisher, B. I. L., and Others.—Your kindly remarks about our libel action are both welcome and encouraging. We have not half finished with the matter yet.

Vox Populi.—Before accepting the advertisement we thoroughly tested the appliance, and our tests were quite satisfactory. In addition to this we invited the opinion of an eminent and impartial medical authority, and that opinion thoroughly warranted our acceptance of the advertisement. This medical certificate is embodied in a letter to us, but we shall be glad to show you it, if you care to call

WELLCOME LIBRARY INSTITUTE

BATTERY